

Retrieval and Dissemination of Information in Distributed and Wireless Environments

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Abstract: This paper investigates a framework for Secure Retrieval and Dissemination of Information (text and image) in Distributed and Wireless Environments (SECRET_DIDWE). Our research focuses on the evaluation and integration of Information Retrieval techniques. Text Retrieval and Content Based Image Retrieval techniques are mainly studied for use in medical environment. The framework is based on a wireless architecture to enable authorized medical personnel to access medical records in a secure and transparent manner, utilizing an agent based architecture. A policy-based architecture is part of the framework for utilizing wireless sensor devices, advanced network topologies and software agents to enable remote monitoring of patients and elderly people. These technologies can be used to achieve continuous monitoring of a patient's condition. Medical information classification based on neural network techniques of SVM (Support Vector Machines) type for supporting diagnosis is also incorporated into the framework.

Keywords: Information Search and Retrieval, Pervasive/Ubiquitous Healthcare, SVM and Diagnosis, Security.

A framework for the retrieval and dissemination of information

Several applications in special purpose Distributed and Wireless Environments are related to Secure Retrieval and Dissemination of Information. In this section, we present the SECRET_DIDWE framework including four main mechanisms:

- 1) An integrated mechanism for Retrieval and Dissemination of Information. This mechanism is based on the expansion of Information Retrieval techniques e.g. text retrieval, personalization, Content Based Image Retrieval, in order to apply them in applications in Distributed and Wireless Environments.
- 2) Design of a Mechanism for Transparent Information transfer using intelligent agents
- 3) Design of a Mechanism for secure medical information transfer in ad hoc networks
- 4) Networked collaborative SVM based classification for supporting diagnosis.

Figure 1 illustrates the role of retrieval and dissemination of information in distributed and wireless environments. The components-mechanisms establish a conceptual framework for several applications. Among else, the components of a SECRET_DIDWE system consist of information retrieval, content based retrieval, image retrieval. Cross Language Information Retrieval (CLIR) is related with the

possibility to support several different languages, and it is devoted to overcome language boundaries. At the case of the Content-Based Image Retrieval systems (CBIR) image retrieval is usually conducted using both textual and visual features. Personalization and user models are essential part of the conceptual framework. Personalization is simply defined as the process of making information systems adaptive to the needs and interests of individual users. Web personalization concerns data collection about the users. A number of different techniques could be used for personalization, e.g. the traditional SDI - Selective Dissemination of Information, user models, stereotypes, and user communities. Several technologies can be applied to IR systems and personalization systems: Machine Learning, Genetic Algorithms, Neural Networks, Fuzzy logic, etc.

Discussion of the framework

In this section we present some research results supporting the proposed SECRET_DIDWE approach. Such contributions follow the four main directions/mechanisms described in the previous section:

1. An integrated mechanism for retrieval and dissemination of information.

The integrated mechanism could be based on the expansion and the application of Information Retrieval (IR) techniques. This mechanism mainly integrates two categories of IR which are of prime interest for applications in special purpose environments: Text Retrieval and Content Based Image Retrieval. Therefore, the mechanism must support: (a) text retrieval, e.g. medical text retrieval, (b) image/video retrieval, e.g. Content Based Image Retrieval, Facial recognition, and (c) Integrated Information (text and image/video) Retrieval. Multilingual Retrieval or/and Cross Language Information Retrieval on multilingual texts, parallel texts, etc., must be also examined. The particularities of languages must be also examined. For example, Greek language has a rich inflectional system, and complex syntax that have to be examined when you conduct text retrieval in Greek text corpora.

To create an integrated mechanism/platform we could use Fuzzy techniques, and Lattice-Valued logic (Kaburlasos, 2012). Especially, fuzzy inference (Kaburlasos and Kehagias, 2014), fuzzy D-Implications (Hatzimichailidis et al., 2012) etc. can be used for expanding the traditional techniques of facial recognition, and can also be applied in the context of the Content Based Image Retrieval, to search and access images of several thematic categories e.g., collections of medical images (Papakostas et al., 2013), (Kaburlasos et al., 2013), (Papadakis et al., 2012). Stemming, and other linguistic tools for Greek language can be incorporated into the mechanism (Karanikolas et al., 2012), (Karanikolas, 2013), (Galiotou et al., 2013), (Karanikolas, 2014). Indexing of Greek text can also be based on (Galiotou, 2014), (Galiotou et al., 2014). Expansion of IR techniques useful for applying into the mechanism include (Tsoukalas et al., 2013), (Fragos et al., 2014). Ex-

amples of special purpose applications which can use an integrated approach for IR include Open Government Data (Galiotou and Frgekou, 2013), Knowledge and Information in Nutrition (Karanikolas, 2014), Personal Digital Libraries (Karanikolas and Skourlas, 2014), Text Assessment (Karanikolas, icininfo 2014). It is worth mentioning the importance of ontologies for use in the integrated mechanism (Tsolakidis, 2014), (Gkinos, 2014).

2. A Mechanism for Transparent Information transfer using intelligent agents

The mechanism can be based on the design and implementation of software applications using agents in distributed environments. To examine a case of prime research interest, we can focus on the transparent and secure communication in distributed medical environments. In this case, we have to examine applications in two directions: (a) End to end secure communication in ad-hoc assistive medical environments using secure paths, (b) Providing advanced remote medical treatment services through pervasive environment. Finally, benchmarks of the applications in distributed environments have to be specified.

There are various research findings useful for the design of a mechanism for Transparent (medical) Information transfer. Belsis and Vassis (2012) use Wireless Sensor Networks to find solutions in Electronic Patient Records Management. Vassis et al. (2012) study the case of an Ad Hoc-based ERP for medical treatment provision in Crisis conditions. Vassis et al. (2013) study how to use agents in medical Ad Hoc networks. Belsis et al. (2014) discuss an agent based Architecture Benchmark. Wireless architectures for assistive environments in a different context (Mobile Learning) are also studied (Marinagi and Skourlas, 2012) (Vassis et al., 2013). New directions for pervasive computing in logistics are also examined (Marinagi et al., 2013)

The use of the mechanism for transparent information transfer could be combined with an integrated mechanism for information retrieval using lattice computing (Papakostas and Kaburlasos, 2014) and (fuzzy) Interval Numbers (Kaburlasos et al., 2013 FUZZ). Facial recognition schemes (Papakostas et al., 2013) and speed emotion recognition (Anagnostopoulos and Skourlas, 2014) could be useful for (medical) assistive environments, and especially in medical treatment provision in Crisis conditions. Ontologies and controlled vocabularies could be also used for several specific purpose environments (e.g. see Skourlas et al., 2014).

3. A Mechanism for secure medical information transfer in ad hoc networks

The mechanism can be based on software applications for secure medical information transfer which use a Wireless Distributed Framework. In this case, we have to examine: (a) design of a platform for information transfer in special purpose networks, (b) techniques of composing ad-hoc and self-organized networks, (c) selection of proper routing algorithms according to the special characteristics of the distributed environments, and (d) adaptation and expansion of existing security models for supporting the non-existence of centralized administration of ad-hoc networks.

There are various research findings useful for the design of a mechanism for secure medical information transfer in ad hoc networks. Vassis et al. (PCI' 2012) study secure management of medical data in Wireless Environments. Belsis et al. (2011) also study the secure management of electronic healthcare records in wireless environments. Belsis et al. (2013) describe a Wireless System for Secure Electronic Healthcare Records Management. Zafeiris et al. (2013) study flow mobility across different devices. Belsis et al. (2014) describe an integrated architecture for Medical Services Provision. In a different context (learning environments), Belsis et al. (PCI' 2012), Marinagi and Skourlas (2013), and Marinagi et al. (2013) study Secure Wireless Infra-structures for Mobile Learning, Blended Learning, and assistive environments in Higher Education. Andrikopoulos and Belsis (2012) propose solutions for effective organization of medical data. Formal concepts (Kaburlasos et al., 2014) could be interpreted as descriptive decision-making knowledge (rules) induced from the data. Formal concept analysis can be applied for modeling and redesigning the medical processes.

4. Networked collaborative SVM based classification for supporting diagnosis.

The mechanism can be based on a software application for supporting diagnosis. Such an application (tool) can be based on the neural network techniques of the SVM (Support Vector Machines) type that are popular today.

Vassis et al. (AIP, 2014) conduct a comprehensive review of the use of neural networks and SVMs for automatic medical diagnosis. Vassis et al. (IEEE MILCOM, 2014) study Video Sessions over Ad Hoc Networks Using Neural Classifiers. Kampouraki et al. (2013) describe e-Doctor, a Web Based Support Vector Machine for Automatic Medical Diagnosis. Such a tool based on neural networks, and techniques for networked services can be used by doctors and medical staff to help decision support by conducting classification, recognition etc., and it is an essential part of the diagnosis system. Christopoulou et al. (2014) study Sharing Knowledge and Integrated Information in Therapeutic Radiological Physics. Communities of Practice (CoPs) can be seen as a strategy for sharing medical information/knowledge, and supporting collaborative work.

Conclusions

Secure Retrieval and Dissemination of Information (text and image) in Distributed and Wireless specific purpose Environments (SECRET_DIDWE) is a framework aiming at the design of an integrated e-Health service that will enable the automated collection, processing (mining), delivery, adaptation, personalization and exchange of medical content. Although SECRET_DIDWE is basically about the effective use of ICTs in e-Health, it can make contributions to several research fields: text retrieval, CBIR, Personalization, Fuzzy Systems (INs etc.), facial recognition), secure and transparent information transfer using intelligent agents, secure dissemination of electronic healthcare, neural networks for supporting diagnosis, mobile computing, etc.

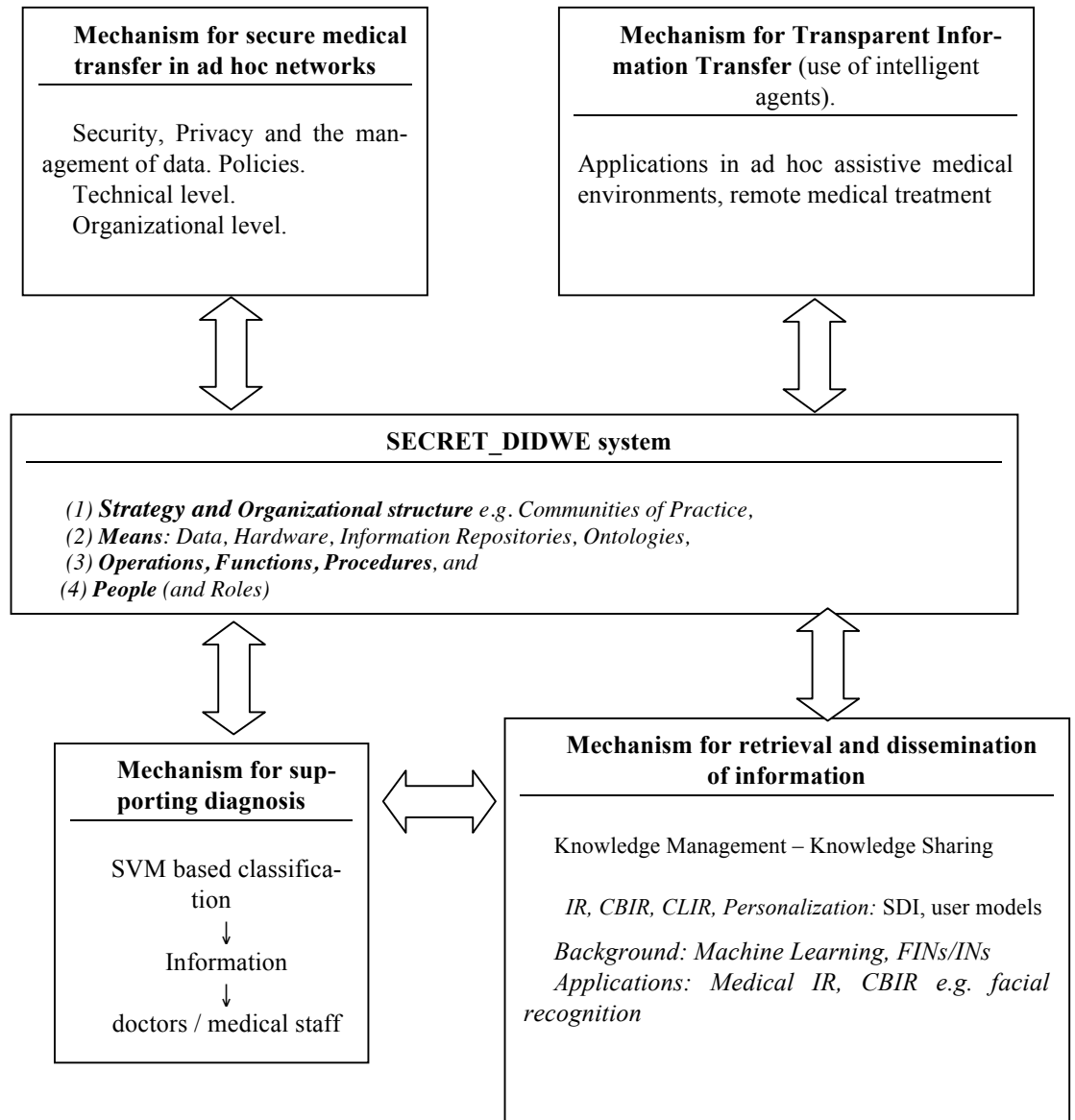


Fig 1 The Role of Retrieval and Dissemination of Information in Distributed and Wireless Environments. Four mechanisms based approach for Healthcare applications.

Therefore, the described framework establishes a theoretical foundation, and conveys development experiences based on pilot systems/research tools. In the future, we should work for an end-product based on the SECRET_DIDWE framework. Such a product targets a growing number of doctors / nurses in the hospital environment that use web and mobile applications to access information relevant to their patients. As such, the SECRET_DIDWE based product is expected to be useful in the promotion and dissemination of e-services. Although we will focus on an e-Health service it will be applicable to any other similar e-service.

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