A System for the analysis of health data, based on Sesame and Android

Rosario Salvatore Barbagallo, Giuseppe Pierpaolo Buemi
Department of Electrical, Electronics and Information Engineering,University of Catania Italy,
Email: barbagallosaro@virgilio.it, gpbuemi@gmail.com

***Abstract* – In this paper a system for the analysis of health data is presented. This system consists of three main components: Java software for the management and sending of patient data, a server based on Apache Tomcat and Sesame to manage the repository and an Android's application for accessing data.**

1. INTRODUCTION

Information technology has an increasingly important role in medicine. Interaction between the two sectors has led to a branch of computer science, called medical informatics.
The medical informatics is the application of computers and communication technologies in all fields of medicine. It uses resources and methods to capture, store, analyze, communicate, and view the medical information. The aim of medical informatics is to facilitate understanding and improve the accuracy of the operational decisions. The traditional information of patient (paper-based) and direct examination have long series of restrictions. These limitations include the lack of completeness, uniformity and sometimes the indecipherability. Also, the limitations of the clinical examination of the patient include no systematic method of recording anamnesis and observation of the signs and symptoms.
The I.T. give the doctor a quick and easy access to information and a clinical picture of the patient clearly and completely.
In Italy and Sicily in particularly, takes place a retraining of health care.
It provides for the development of integrated management of patients, particularly patients with chronic diseases such as type 2 diabetes and chronic heart failure.
The Region of Sicily has developed two applications:

- Start-Up Heart Failure
- Start-Up Diabetes Mellitus Type 2

These applications allow doctors from enter patient data and then send the data to the ASP (Provincial Health Authorities).
The system of analysis developed is integrated with the use of applications "Start-Up" developed by the Region of Sicily. Its objective is to achieve a semantic organization of data sent by the doctors.
It also provides a service of consultation for medical data of their patients.
The system is based on Java [1] software for the management and send of patient data, a server based on Apache Tomcat [2] and Sesame [3] to manage the repository and an Android's application [8] for accessing data.

2. SESAME AND RDF SCHEMA

To manage the data sent by the doctors has been used Sesame. It is an open source framework that allows the management of semantic repository. It allows the management of ontologies and metadata in RDF, RDF Schema and OWL.
For the realization of the structure of the repository is used the standard RDF. RDF (Resource Description Framework) [9] is a W3C standard for describing web resources. Each resource is identified by a URI.

The RDF model is based on:

- resources
- property
- values

Properties are the relationships between resources, the values are primitive data types.

The basic unit to represent information in RDF is the statement, made by:

- subject (resources)
- predicate (property)
- object (values)

RDFS (RDF Schema) is an extension of RDF which allows to define classes and properties specific to a particular application.

3. APPLICATION SIDE DOCTOR SEND DATA

For integration with applications developed by the Region of Sicily [11] , has been made a Java software. It allows the doctor to manage core operations to be made. At the first start, the doctor must enter information that will be managed by a suitable encryption system.

Once registered, the doctor has available an interface that allows you to perform basic tasks:

- add or remove programs “Start-Up”;
- use the programs “Start-Up “;
- sending data entered to ASP;
- documentation of consultation for programs “Start-Up”.

Fig. 1: Application side doctor, send data.

4. APPLICATION SERVER SIDE

The Server for data management is divided into two components:

- component for managing the repository;
- management component of the web service.

The management component of the repository uses Apache Tomcat and Sesame. Apache Tomcat is an open source web container, which provides a platform for running web applications developed in Java. It allows to set the framework to create a Sesame repository for semantic data.

The structure of the repository is done through an RDF Schema, which organizes information from the data received.
This component uses the SSH protocol [5] for secure reception of data sent by the doctors. After receiving the data, the component parses the data to get a file in XML format [3]. The resulting file, created based on the structure of the RDF Schema, is included in the semantic repository.
The second component (managed by the web service) exposes methods to retrieve the information contained in the semantic repository.

The information are retrieved through the use of SPARQL query [10] from the repository.
SPARQL is a query language for RDF that allows to extract information from a semantic repository.
RDF defines concepts and relationships through the statement, if there are any common elements emerge a graph of knowledge. SPARQL allows to search the sub-graphs corresponding to the request made by the query.
In the system, the communication between the web service and the application Android is through HTTPS .
HTTPS is a protocol that allows the transfer of confidential data on the web, creates an encrypted communication channel between the client and the server through an exchange of certificates. Given this channel is used inside the HTTP protocol for communication.

5. APPLICATION SIDE DOCTOR REFERENCE DATA

The system of data analysis is part of the medical informatics. For this reason we have developed an application for a device (PDA) running Android.

The Android application allows to do:

- see patient information;
- see the statistics of the patients.

When the program starts, the doctor must enter code and password provided from the ASP.

Fig. 2: Login page of Android application.

The Android application sends the login data through an HTTPS request [7] to the web service and waits for the result of authentication.
If the outcome is positive, the doctor through a specific interface, can consult the list of the patients or some statistics information.

Fig. 3: Home page of Android application.

The list contains the patient name, last name and social security number of each.

The doctor interacts with the list and can access the information of the individual patient. The information displayed are about the disease that affects the patient, heart failure and / or diabetes mellitus.
The information are taken from the semantic repository through an HTTPS request by Android application, which invokes a method exposed by the web service.

This application has a toolbar that allows navigation and access to a page to search for a particular patient. Research is carried out through the first and last name.
The information of the patient's pathology (heart failure/diabetes mellitus) allow the doctor:

- easy and fast consultation;
- monitoring of the clinical situation;
- optimal diagnostic and therapeutic decision.

Also, the application allows doctors to see the statistics of patients.
The doctor has the opportunity to see a pie chart that shows the percentage of patients with heart failure, the percentage with diabetes mellitus and the percentage of those suffering from both diseases.

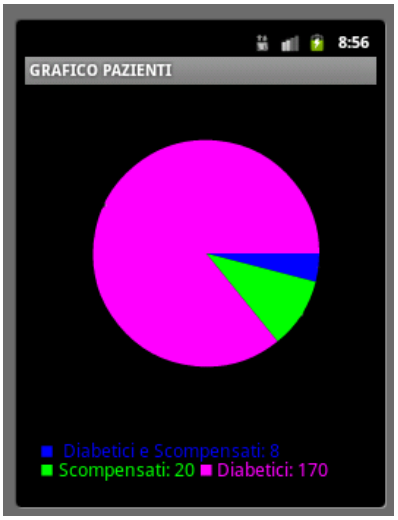

Fig. 4: Pie chart of Android application.

The doctor may refer to another type of chart that displays the number of patients divided by age and sex with a given disease.

A final type of consultation consists of two phases:

- in the first phase, the doctor may select up to five parameters characteristic of the disease;
- in the second phase is shown on a graph the number of patients with selected parameters.

These graphs allow the doctor to perform qualitative assessments on its catchment area, assessing the overall progress of the disease and to observe any anomalies.

CONCLUSIONS

The system of data analysis is an help to the conduct of medical activity.
The doctor (thanks to the system) has a clear view on the clinical data of the patient. Access to data through the Android application allows high speed and usability. The system provides a tool for faster and more complete diagnosis.
The whole system provides to the doctor, thanks to SSH and HTTPS protocols, the maximum data security and privacy of patients.

Possible future developments could include:

- increased interaction between the Android application and the web service, for the use of new functionality;
- semantic repository management through fuzzy logic.

References

[1] www.java.com
[2] http://tomcat.apache.org/
[3] http://www.jdom.org/
[4] http://www.openrdf.org/
[5] http://www.cygwin.com/
[6] http://axis.apache.org/axis2/java/core/
[7] http://ksoap2.sourceforge.net/
[8] http://developer.android.com/index.html
[9] http://www.w3.org/RDF/
[10]http://www.w3.org/TR/rdf-sparql-query/
[11]http://www.regione.sicilia.it/sanita/