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Normalized medical information visualization

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Abstract. A new mark-up programming language is introduced in order to facilitate and improve the visualization of ISO/EN 13606 dual model-based normalized medical information. This is the first time that visualization of normalized medical information is addressed and the programming language is intended to be used by medical non-IT professionals.

Keywords. Health Information Systems, Medical Records Systems, Computerized

Introduction

Normalization is a crucial and highly requested characteristic of today's medical information. It enables information to feature semantic interoperability between medical Information Systems. This property is achieved through the implementation of the so-called dual model which separates information (Reference Model) and knowledge (archetypes, see below) into two different levels.[1] This separation is performed by the ISO/EN 13606 standard used in this work.[2]

However no attempt has yet been made in order to perform a systematic study of the visualization and presentation of the normalized medical information for the user, who may also want to visualize information in a subjective way.

Standard XML editors and visualizers do not take into account the special properties of normalized EHR (Electronic Health Record) extracts XML files, i.e. its structure constrained by archetypes.[3]

A new XML-based mark-up programming language is being developed in order to investigate the visualization of ISO/EN 13606-based normalized medical information, allowing medical practitioners to visualize information in a subjective, practical and user-friendly way.

1. Methods

Figure 1 shows the structure of a ISO/EN 13606 and ISO 21090 [4] normalized medical Knowledge Management System generating EHR files, using the new

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language (in yellow). The new language marks up the Reference Model and the archetypes of the dual model with special visualization codes. This gives rise to the two parts of the language: RM ML and ARQ ML. Two corresponding mark-up language

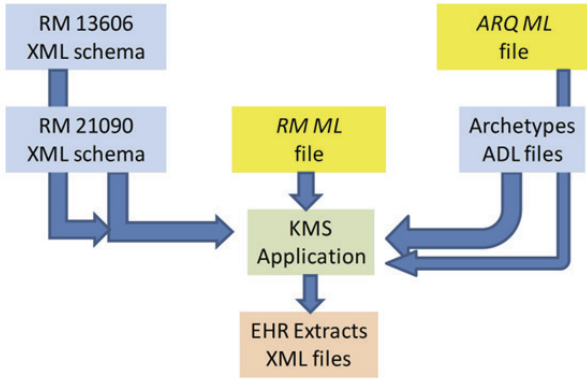

Figure 1. A normalized Knowledge Management System using dvML.

files mimicking, but not altering, the RM (RM ML) and the archetypes (ARQ ML) are built. The visualization codes fall into four categories: visibility (whether a specific element of the EHR extract will be visualized at all), format (how it will be visualized i.e. panels, tables, text, ...), expansion (how it will be expanded i.e. grid or new window) and colour (if some element will be stressed in a specific colour).

RM ML addresses the visualization strategies for generic elements in the ISO/EN 13606 Reference Model. However many visualization modes may refer to the specific structure of medical domain knowledge as stated in the archetypes (ARQ ML).

2. Results

The formal grammars of the two parts of the new language are represented by single-type tree grammars. These grammars are used to describe the permissible trees represented by XML files. RM and ARQ ML can thus be defined using W3C XML schemas which is the tool used to develop XML-based mark-up languages. These schemas create a collection of names and attributes used by the language, mimicking the RM and the archetypes of the dual model.

W3C schemas of the ISO/EN 13606 RM are used by the Knowledge Management System (KMS) to build an in-memory Java class representation of the EHR extract tree. This Java class representation is performed using JAXB (Java XML Binding) technology. The Java classes are created automatically out of the XML schemas representing the RM.

The archetypes of the dual model are represented by ADL (Archetype Description Language) files.[5] This language is also defined in the ISO/EN 13606 standard, and a Java class representation of the standard's Archetype Object Model used to build up ADL described archetypes has been constructed using an ADL parser..

When an extract XML file is loaded from disk an interpreter of the new language traverses its in-memory tree representation and annotates it with the visualization tags specified by the RM and ARQ ML files in order to visualize each element..

3. Discussion

Normalized medical information seems to have special characteristics different from 'medical information'. The principal difference would be imposed by the structure of the knowledge normalizing archetypes. Archetypes have a logical structure that tends to group related medical concepts together in panels containing many label-element pairs or in tables containing rows and titled columns of cells representing elements.

The most frequent table structure imposes a tabular-like visualization methodology in order to encapsulate the grouped structure of medical knowledge, i.e. rows are examples of items with grouped related characteristics represented by titled columns, the intersecting cell holding the value for the item of the corresponding characteristic.

Like the CSS (Cascade Style Sheets) language,[6] the new language uses selectors, properties and values. However, CSS has no GUI values and it would be impossible to instruct the system to visualize some element as a specific GUI, a table for instance. Another related difference is that the new language tags XML schemas, while CSS tags XML files. These differences make necessary the use of the new language instead of CSS.

Extensible Stylesheet Language (XSL) [7] presents similar problems because it tags XML files instead of XML Schemas. Even when it would be possible to program a whole GUI in XSL it would be such a complicated task, even at its high level specifications, as to prevent non-IT professionals such as medical practitioners to do it. The new language is intended to be used by medical non-IT professionals.

Subjective visualization is controlled by medical practitioners by programming special marked-up files written in the new language. Medical practitioners may decide what they want to visualize and how they will do it. They do not always want to visualize the same things or in the same way. The new language enables subjective information visualization and permits practical and user-friendly work.

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