A Novel Graphical-Oriented Framework for Capturing Data within Clinical Information Systems

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ABSTRACT

One of the main challenges in the development and implementation of computerized health care systems is the physicians and nurses’ resistance, stemming in particular from the use of text based environments for the capture of their medical examination data. The purpose of the present study was to propose the basis for a graphical oriented framework which can be used to capture data for a medical examination therefore easing the data-entry using the keyboard. Following analysis of a classical general medical examination, an XML schema was designed to describe physical examinations. Based on the physical examination XML schema, XML data structures are transformed to HTML using XML transformation style sheets to create dynamic graphical user interface (GUI) widgets; user interactions with the widgets leads to the generation of sentences. The key advantages of the proposed system are: a) a reduction in the keyboard usage, b) the ability to codify the generation sentence accurately and c) an operating system platform independence. A prototype of usage of the above framework is also presented.

Keywords: Clinical Information System, Electronic Patient Record, Graphic User Interface, Natural User Interface, Physical Examination, Schema, Structured Data Entry (SDE), XML

INTRODUCTION

Clinical information system (CIS) is one of the core modules of any hospital information system. CIS include two main components: CPOE and electronic patient record (EPR).

EPR comprises a variety of data; amongst them are physical examinations and progress note. These clinical data should be keyed into the EPR by respective caregivers, mostly physicians and nurses. Clinical staff generally resist using the computer keyboard so as to enter these data into clinical information systems (Kent, 2001). The reasons for this resistance...
are basically attributed to the time and effort needed for completing the task. In today's medical practices, complex multi-tasking is common among healthcare providers, so time has become precious and the attention span of these caregivers have become shorter.

In recent years, a significant number of developments has affected human-computer interaction (HCI) particularly on challenges of user interface. In the context of medical informatics, the evolution of HCI as “a science of design,” appears to be promising for the improvements of developing future user interface of all electronic patient record systems. User interface studies show different measures used as standards for CIS use and evaluation. The most important one is the usability of software which can be defined as the capacity of the system to allow users to carry out their tasks safely, effectively and enjoyably. In the field of medical informatics, issues of usability have come to the fore as the ultimate acceptance or rejection of systems such as computerized patient records depends, to a large extent, on their usability. Results obtained from the study of physicians’ interactions with computer-based patient record systems involving physicians to think aloud while interacting with systems in a “usability laboratory”, as well as the analysis of doctor-patient interactions, involving the use of computers in natural clinical settings, have shown the importance of user interfaces that are adaptive to the type of clinical practice as well as the level of expertise systems users. Another key measure for the evaluation of user interfaces is adaptability. There are several approaches to providing adaptability in user interfaces; this ranges from those that allow users to customize their interface to systems that automatically modify their presentation of information for particular medical situations. Users are typically dissatisfied with systems that are created without enough considerations to these aforementioned measures, and often such systems are abandoned. In order to leverage such systems, a combination of computer science, cognitive science and human-computer interaction could form the designing framework for generating effective user interfaces. In developing future adaptive interfaces, consideration must be given to both the system’s ability to “calibrate” to the user’s needs, and to the evolution of the users’ knowledge and skills over time as they interact with the system (Johnson, 2005).

Direct manipulation interface is an interface that provides a visual representation of the required tasks through the use of objects or icons based on business processes that mimic the users’ tasks. The benefits of such an interface based on metaphors are easy to learn, decreased human errors, and ease reversal of actions (Johnson, 2005).

By reviewing the contributions of various authors, the “acceptance is the result of an affective and a cognitive evaluation of an end-user regarding to internal (past experiences, expectations, etc.), external (context of use, etc.) referents and multiple factors of variable weights implied in his experiment with an information system.” (Despont-Gros, 2004).

Harmonization of the system with the real world is one of critical points of interface design. The system should speak the user’s language, with words and concepts familiar to the user, rather than system-oriented terms, following real-world conventions, making information appear in a natural and logical order. Making objects, actions, and options visible is important too. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable (Chan, 2002).

Health care staff resistance to use clinical information systems has given computer programmers an increased impetus on reducing data entry tasks. Structured data entry, that is data entry based on the selection of predefined medical concepts, is indispensable for having consistency and quality of data, easy reporting, establishing decision support systems, and patient-oriented clinical research. Physician data entry (PDE) has been a key barrier to replacing paper records with a CPR. A majority of interfaces have been designed on the basis of the functional requirements and few studies have documented methods to elicit interface
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