

一個以 RSS 為基礎的臨床資訊提醒系統

An RSS-based Clinical Information Reminder

溫嘉憲
Chia-Hsien Wen
靜宜大學
資管系
chwen@
pu.edu.tw

林志育
Chih-Yu Lin
靜宜大學
資管系
cylin@
mis.ccu.edu.tw

吳任航
Jen-hang Wu
靜宜大學
資管系
S9471315@
pu.edu.tw

李冠憬
Kuan-Ching Li
靜宜大學
資工系
kuancli@
pu.edu.tw

陳金榮
Chin-Jung Chen
台中榮總
資訊室
ccj438@
vghtc.gov.tw

潘錫光
Sek-Kwong Poon
台中榮總
肝膽胃腸科
psk@
vghtc.gov.tw

摘要

本論文設計並製作一個以 RSS 技術為基礎的臨床資訊提醒系統，用來提醒臨床醫師尚未完成的各類臨床例行工作。系統將從醫院資訊系統中自動收集臨床資訊，並將其轉換成 XML 格式的 RSS 臨床訊息，傳遞給每位臨床醫師。臨床醫師在登入醫院資訊系統時可藉 RSS aggregator 接收和閱讀這些訊息。系統中的每一個 RSS 訊息皆提供超連結到對應的 HIS 應用作業，讓臨床醫師可以很容易地立即對訊息給予回應，因而免除耗費精神於臨床瑣事上。

關鍵字：RSS, CPR, XML

Abstract

A clinical information reminder using RSS technology is designed and implemented for reminding clinicians of their miscellaneous unfinished clinical chores. The reminder will automatically collect clinical information for every clinician from the hospital information system (HIS) and transform them into XML-formatted RSS clinical messages. By way of an RSS aggregator, a clinician will receive and read these messages whenever he/she logs on the HIS. Each RSS message of the reminder provides a hyperlink to the appropriate application that let the clinician may easily give some response to the message. Clinicians will be free from keeping track of clinical chores.

Keywords: RSS, CPR, XML

1. Introduction

A computer-based patient-record (CPR) system is designed to overcome many limitations of traditional paper-based patient records. One of the important CPR functional components is clinical decision support that may prevent medical errors and improve patient safety by providing reminders and alerts at the time that a physician is making ordering decisions [1, 2]. Since timely and accurate patient information is required for clinical decision support, it is reasonable that a CPR system will provide functions to remind clinicians to accomplish the unfinished portions of a medical record in time. Because a clinician generally has to take care of several patients, it is a heavy burden for him/her to remember all kinds of tedious clinical chores. If a CPR system is equipped with a reminder that may automatically send clinical messages to a clinician and remind him/her to give some appropriate responses as a "to-do list", then he/she will be released from keeping track of what is going to be processed. This feature can be fulfilled by embedding the RSS mechanism into CPR systems.

RSS, which can stand for Really Simple Syndication, Rich Site Summary or Resource Description Framework (RDF) Site Summary, is a data exchange protocol for sharing web contents. It may simplify and speed the users' access to the latest updated information which is published by a web site. The publisher web site creates an RSS file, also known as RSS feed or RSS channel, in

which the content to be published is transformed into an XML-based format. Any user can read the RSS feed at different sites at the same time by way of an RSS aggregator (RSS reader). An RSS aggregator is an application providing the means to read the content of RSS file before it can be displayed [3, 4, 5]. RSS is generally used in real-time news reading and publication information management [6, 7, 8]. No evidence shows that there is any RSS-based medical application.

An RSS-based clinical information reminder is implemented under the support of Taichung Veterans General Hospital in Taiwan. The reminder is coupled with hospital information systems (HIS). It will periodically collect clinical information required by clinicians from HIS and transform them into RSS messages automatically. A clinician will receive these RSS clinical messages sent to him/her whenever he/she logs on HIS. The reminder is also associated with the LDAP server of HIS for user authentication to protect patient privacy.

```
<?xml version="1.0" encoding="Big5" ?>
<rss version="2.0">
  <channel>
    <title>Abnormal Examination Results</title>
    <description>Abnormal Examination Results Notification
    </description>
    <link>http://intm.vghtc.gov.tw/imd/index.htm</link>

    <item>
      <title>Patient's name: Nick</title>
      <link>AER_01.xml</link>
      <description>Doctor's ID: 0110C</description>
    </item>
  </channel>

  <channel>
    <title>Consultation Notice</title>
    <description> Consultation Notice Notification </description>
    <link>http://www3.vghtc.gov.tw/surgery/index.html</link>

    <item>
      <title>Patient's name: David</title>
      <link>CNN_01.xml</link>
      <description>Doctor's ID: 3122B</description>
    </item>

    <item>
      <title>Patient's name: Sun</title>
      <link>CNN_02.xml</link>
      <description>Doctor's ID: 1244A</description>
    </item>
  </channel>
</rss>
```

2. The Basics of RSS

Web content to be published must be transformed into RSS feeds in XML format. The following example shows the syntax of an RSS feed:

The first element of an RSS feed is the <rss> element. There is at least one <channel> element in the <rss> element. A <channel> element is the main container for all RSS data. It is specified with the <title>, <link> and <description> elements and consists one or more <item> elements. An <item> element also contains a <title>, <description> and a <link> element to a web page. The <title> element is the title of the channel/item in text you want to display. The <link> element is a hyperlink to a web page that corresponds to the RSS feed or the URL of the specific item if it is within an <item> element. The <description> element describes the RSS feed or the item [5,9].

RSS aggregators are applications used to read content of RSS files. These RSS-format handling applications can be web-based standalone programs, web-browsers or e-mail-clients. In general, there are three common types of RSS aggregators. The first type RSS aggregator, Desktop RSS aggregator, is the standalone program. Users download this program to their computers from Internet and use it to collect the feeds and refresh items when a feed is updated. Web-based aggregator, the second type, is a kind of online web service. Users can use it to collect the feeds and browse messages in Internet. The final type is Plug-in aggregator which allows users to view RSS feeds with an existing program such as Microsoft Outlook [5].

3. System Design

Figure 1 shows the system architecture and its operation flow of the designed RSS-based clinical information reminder. Both the RSS aggregator and the database

server of the reminder are designed in a single server, the RSS server. The reminder works by way of coupling itself with the HIS of a hospital. The RSS server periodically collects XML-formatted clinical information from HIS and save them into the RSS database as RSS clinical messages. The RSS feed is created concurrently.

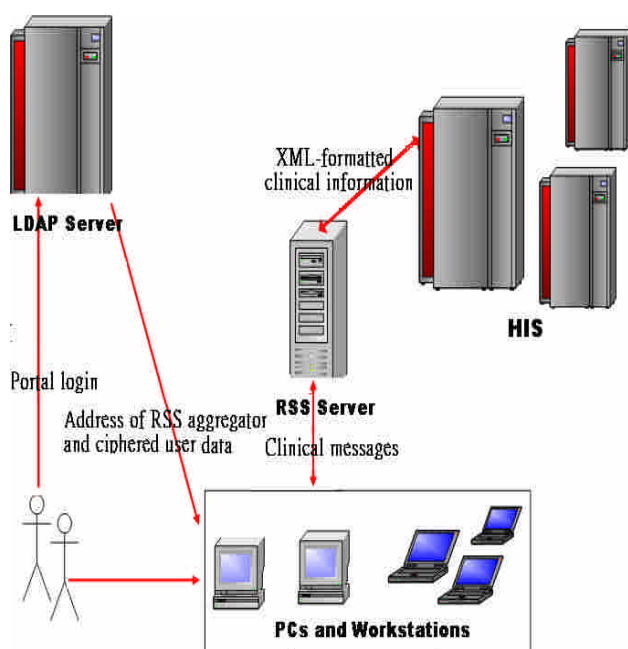


Figure 1. The system architecture and its operation flow of RSS-based clinical information reminder

Figure 2 shows an example of RSS clinical messages stored in the clinical information reminder. The data structure of the reminder consists of an index-file and many data-files. The index-file is the RSS feed that lists some important attributes, such as patient id, data-file name, and physician id of all data-files. A data-file records detailed data of a clinical information. Both of the index-file and data-files are in XML format conformed to RSS 2.0. A <channel> element of the RSS feed represents a class of RSS clinical messages. There will be n <item> elements in a channel, if there are n RSS clinical messages in the class. The patient id, data-file name, and physician id of an RSS clinical message are stated in <title> element, <link> element, and <description> element of an item respectively.

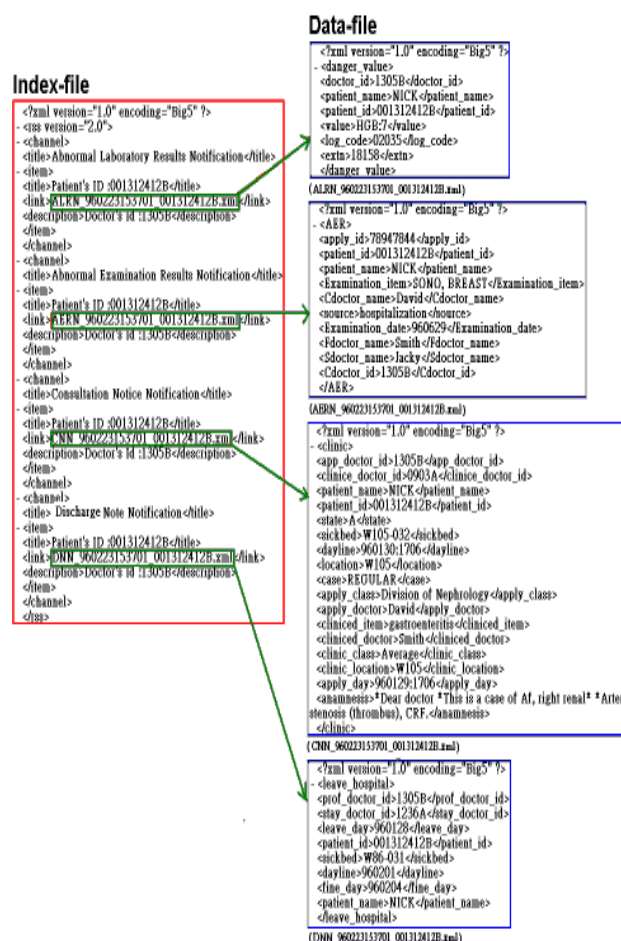


Figure 2. An example of clinical messages stored in the clinical information reminder

Since a clinician will not always use a specific client, the RSS aggregator of the reminder is designed as a web-based, the second type, aggregator. The RSS server performs event-driven RSS syndication, because only those messages with matched doctor's id will be retrieved and displayed to the user [2, 5]. Whenever a clinician logs in HIS, the LDAP server will pass the address of the RSS aggregator and ciphered user data to the RSS server to initiate the reminder after authentication. The aggregator will get the RSS feed and pick up those items whose doctor's id in <description> element match with the one obtained from the LDAP server. A matched item represents a sound message. Then the aggregator passes the list of sound messages to the RSS server and requests it to retrieve sound messages from RSS database. All sound messages are displayed for advanced process by the clinician.



Figure 3. An example of transforming an abnormal examination results notification message into an archived one



Figure 4. An example of deleting a discharge note notification message

Unlike general RSS news behavior, a read RSS clinical message will still be displayed unless it is removed manually. Although a message has been read, it may leave something to be done. A two-phase message removal is designed. As shown in figure 3, the first phase let a user transform selected messages into archived messages by clicking the right bottom of the mouse and choosing the “remove” item. Archived messages in RSS database will be flagged, and will not be displayed anymore. When the user wants to delete some messages forever, he/she has to click the “archived messages” item in the class list and select those wants to be deleted.

By clicking the right bottom of the mouse and choosing the “delete” item, all selected messages will be deleted from the RSS database. Figure 4 shows an example of the second phase of message removal.

4. System Implementation

The reminder is developed using the VB.net programming language and Microsoft SQL Server 2000. Figure 5 shows an example screen about abnormal laboratory results notification. The left part of the screen is a class list of RSS clinical messages. There are four classes of RSS clinical messages currently processed in the reminder: abnormal laboratory results notification, abnormal examination results notification, discharge note notification, and consultation notice notification. Other kinds of clinical information will be joined to the reminder gradually. Archived messages will be shown while “archived messages” item in the class list was clicked. The upper right part of the screen lists all abnormal laboratory results notification messages that the clinician was received. If one of the messages in the list is clicked, detail information of the message will be shown on the lower right part of the screen. The physician may enter into laboratory information system by clicking the asterisk in the “link” field of the message.



Figure 5. An example screen about abnormal laboratory results notification

An abnormal laboratory results notification messages is sent to notify a physician that the result of a laboratory test he/she ordered is abnormal and critical. A number of different kinds of checks, such as range check, delta check, apply to laboratory results. If a test result is verified to be abnormal and out of the acceptable range set in advance, relative information about the abnormal laboratory result, such as patient's name, the laboratory result, and the order date-time will be immediately sent to the physician who ordered this test.

Figure 3 shows an example screen about the abnormal examination results notification. Similar to the appeal of abnormal laboratory results notification, it is used to notify a physician that the result of an imaging examination or a pathology examination he/she ordered is abnormal. Discharge note notification is used to notify a clinician that one of his/her patient is discharged and he/she has to accomplish the discharge note before deadline. Figure 4 shows the RSS clinical messages about a clinician's discharge note notification. A consultation notice notification message notifies a clinician that there is a consultation he/she has to hold. An example screen about consultation notice notification is shown in figure 6.



Figure 6. An example screen about consultation notice notification

5. Conclusions and Future Works

RSS provides a mean to acquire up-to-date information quickly from Internet. Clinicians are generally too busy to keep track of all kinds of clinical chores. This paper presents the design and implementation of an RSS-based clinical information reminder. A clinician may use the reminder to receive all kinds of clinical messages and arrange them as a to-do list. Although the pioneer system only includes four classes of clinical messages, it proves that the reminder will help clinicians in managing clinical chores. If all kinds of clinical information are implemented into the reminder, nothing will be missed even though a clinician is very busy. In the future, the reminder will be expanded by joining more kinds of clinical messages.

RSS is an effective tool to spread internal information. One of the functional components of a CPR system is integrated communication support. A patient-oriented medical record will be the communication tool for team members who take care of a patient. Traditional CPR systems generally provide passive pull-type communication because each team member has to scan through the record to find other's opinion. By including RSS mechanism in a CPR system, each team member's opinion will automatically push to other members.

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