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An Internet supported workflow for the publication process in UMVF (French Virtual Medical University)

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ABSTRACT

The “Université Médicale Virtuelle Francophone” (UMVF) is a federation of French medical schools. Its main goal is to share the production and use of pedagogic medical resources generated by academic medical teachers. We developed an Open-Source application based upon a workflow system, which provides an improved publication process for the UMVF. For teachers, the tool permits easy and efficient upload of new educational resources. For web masters it provides a mechanism to easily locate and validate the resources. For librarian it provide a way to improve the efficiency of indexation. For all, the utility provides a workflow system to control the publication process. On the students side, the application improves the value of the UMVF repository by facilitating the publication of new resources and by providing an easy way to find a detailed description of a resource and to check any resource from the UMVF to ascertain its quality and integrity, even if the resource is an old deprecated version. The server tier of the application is used to implement the main workflow functionalities and is deployed on certified UMVF servers using the PHP language, an LDAP directory and an SQL database. The client tier of the application provides both the workflow and the search and check functionalities. A unique signature for each resource, was needed to provide security functionality and is implemented using a Digest algorithm. The testing performed by Rennes and Lille verified the functionality and conformity with our specifications.

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1. Introduction

The “Université Médicale Virtuelle Francophone” (UMVF) is a federation of French medical schools. The UMVF project involve 27 French medical schools. Its main goal is to share the production and use of pedagogic medical resources generated by academic medical teachers. The resources provided by each school are located on the web sites of the individual medical schools. In order to help the students to find the spe-

cific resources they were seeking, the UMVF decided to use a search engine developed in Rouen, “DocCisMef” [1]. “DocCisMef” is a powerful generic search tool based on a structured information model which uses the MeSH thesaurus to index and retrieve quality health resources on the Internet. A specific version of the search engine: “DocUMVF” is configured for the UMVF project. It is accessible from the main web entry of UMVF and select the results of the search in the pedagogical resources provided by the medical schools involved

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in the project. However, users have always the possibility to extend their search by switching to the DocCismef Interface. This search engine depends on manual indexation performed by librarians, rendering it very difficult for the Rouen team to keep up with the increasing flow of information coming from the individual schools. The solution to this problem was to associate with each new document a standardized description. This "UMVF-notice", SCORM compliant [2], provides all the information needed for an automatic and immediate pre-indexation by the Rouen team. The "UMVF-notice is filled first by authors and webmaster. Then it is eventually completed by an automated indexation tool either in Rennes or Rouen. At the end of the process, the full indexation is manually checked, completed and validated by the librarian team from Rouen.

However, the questions remained: who would really fill in this notice, who would verify its quality, how will the notices be collected, and how the student can assert what they use? For the instructors, the problem was how best to submit to the central office the details of their resources. In the absence of a formal submission mechanism these details might be sent in a variety of ways with no standardization of mechanism of submission, details, version numbers, dates or authors. At the same time, in the absence of standardization, the personnel in Rouen had great difficulties posting the information in a timely fashion. For the Students, the documents referenced on the UMVF web site are widely circulated by a variety of means, such as downloading, and distribution on CDs and disks. The students experienced considerable difficulties determining the author, date of publication and origin of the information, its validity and its accuracy. Without this information, the students were unable to determine whether the document they had in hand was the most current version, nor were they are able to assess the quality of information therein.

We thus sought to create an application which would ensure standardized data entry, assist the webmaster in validating the data, and render the entry of the data into the database more efficient and thus faster. With such an application, the work would be easier for the teachers, the webmasters and the personnel in charge of the final manual indexation.

2. Methods

To build our application we defined specifications which provided the functionality necessary to solve the identified problems. Some of these were related to the solutions we chose, others were related to UMVF organizational constraints.

2.1. Specification for the publication process

For teachers: The tool had to permit easy and efficient upload of new educational resources; these were designated as "primary resources" in this process. It had to be usable from behind hospital network firewalls. The required base functionalities were the ability to add, modify or delete the file of pedagogic medical resources on the UMVF web sites. The tool also had to assist the teacher in filling out the UMVF-notice of the resource, by

pre-filling fields such as file name, medical school, and date. The tool had to be easily deployed on any web site of UMVF's members.

For webmasters: The tool had to provide a mechanism to easily locate new uploaded files, to associate them with their author and to validate them, if necessary after having modified their style settings. The tool had to facilitate the communication between webmasters and librarians for solving indexation problems.

These modified (if necessary) and validated files were designated "secondary resources" in this process. The web master must add the URL for the resource to the UMVF-notice (which was pre-filled by the software and completed by the original author). He must then validate the notice and send it to the indexation centers in Rouen and Rennes. In Rouen, the notices are parsed and integrated in the "DocCismef" database as pre-indexed resources. In a second time, a manual validation by librarians close the process.

For both the teachers and the web masters, the utility had to provide the control and communication functions that define a workflow system [3]. Each user had to have a simple view of the status of the data, resources and associated UMVF-notices for which he was responsible. The teachers needed to be able to see if their data were in stand-by mode, rejected, validated or published; the webmasters had to be able to determine if the author had made any changes to their submissions or corrections to rejected data. And if more information were needed, the workflow system had to allow the webmaster to easily communicate by e-mail with the author, including references to the data with problems.

2.2. Specification for the security properties of resources

An important functionality for students was the ability to verify the validity and integrity of the resources they had downloaded or received from friends. A search on DocUMVF return a comprehensive list of the notices describing the selected resources. These notices provide only a link to the official on-line version of the documents. It was thus necessary to provide a simple means for students to search for the original UMVF-notice from a resource they had in hand. We needed a unique signature for each resource, easy to rebuild from the resource itself, and incorporated into the description. The student's tool should compute the signature of the resource in hand, and use it to search for the corresponding UMVF notice [4,5]. Armed with this description the student would then be able to access the information collected by the indexation team such as key words, topics, versions authors, dates of revision, etc. If the student's copy of the resource was either corrupted or not a valid UMVF notice, the software should identify this fact.

2.3. UMVF organizational constraints

We inherited some constraints directly from the UMVF organization [6]. One was related to the heterogeneity of UMVF users' computers (PC-Windows, PC-Linux, Mac-Macintosh); the application had to run on disparate architectures and operating systems. Another constraint stemmed from national

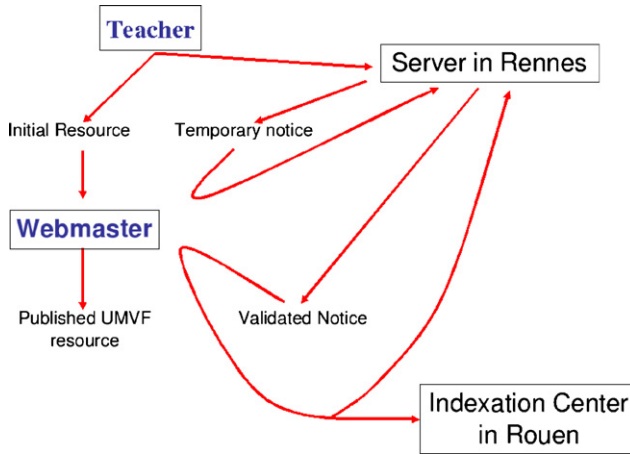


Fig. 1 – The workflow model for the UMVF publication process.

Education Ministry specifications: we were required to use an external directory for authentication and access control, conformant with the university directory specification (SUPAN). A third constraint was a result of the nature of the information system, which is a distributed system in which the resources are distributed across multiple different medical school web sites, 27 January 2006. A further constraint was the use of the extant on-line description editor provided by the medical school of Rennes. This is the means by which a uniform description of the resources is obtained from each medical school. Changes made in these descriptions should affect the application only if the fields used specifically by the workflow application are changed. A final constraint was the need to send the description both to Rennes and Rouen where the two search engines of the UMVF are located (Fig. 1).

3. Results

We developed two applications. The first is the workflow application and the second is the security application.

3.1. The workflow application

The language used was PHP and the development was done by our private partner, Archimed, Lille, France.

The authentication and the profiles are managed in an external LDAP directory which is SUPAN compliant. This choice allows each members to link his publication server to his university LDAP directory. We implemented the application on Microsoft-Windows and GNU-Linux servers with IIS or Apache web server running PHP v5, OpenLDAP Directory and MySQL Database engine. Our application is conformant with Open-Source GNU licensing.

For medical school of Rennes, we had to make some adjustment to connect the UMVF workflow to the university LDAP directory. This directory is not completely in conformity with SUPAN specification. It was necessary to modify the script connexion and access rights management. This setting was done without difficulty and made us to use the teachers accounts possible.

For medical school of Lille, the UMVF workflow was connected to the SUPAN university LDAP directory. All medical teachers are granted to access to the application and they use their university login and password (Fig. 2).

All the medical schools are using the same on-line description editor provided by the medical school of Rennes (Fig. 3). Several modifications were carried out on the XML UMVF-notice. Our aim was to be interoperable with:

- Doc'Cismef search engine: we used a shareable controlled vocabulary (i.e., department, resource types). We also added

Module de publication de ressources pédagogiques - Mozilla Firefox
 https://grumvf.univ-lille2.fr/UMVF/user/view_frame.php

Liste de mes documents

Ajouter un nouveau document

Titre	Date de publication	Etat	Voir la notice	Modifier le document	Modifier la notice	Supprimer
How-To GRUMVF	18/11/2004	En Attente				

To add a new document

To see the state of submitted resources and to allow some modifications

Terminé grumvf.univ-lille2.fr

Fig. 2 – The workflow interface for teachers.

Fig. 3 – The common on-line notices editor.

the modification date which was essential for the integration in Doc'Cismef search engine.

But some improvement were made regarding local specification. For example the Rennes Team has modified the workflow for supporting the Rennes pedagogical network [9]: we added fields to specify curriculum level and a taxonomy (i.e., chapter 1).

We also made some other modifications on the workflow specific to Rennes:

- Procurement module: secretaries had to be able to add resources instead of teachers. Thanks to This module, teachers were able to give procurement without revealing their password.
- URL resources: only files were allowed to be uploaded. Some teachers had their resources on the Web in HTML format. To integrate these resources we added a field to enter an URL instead of a physical resource.

3.2. The security application

In the validation sub-process, a signature is computed as an MD5 sum digest and is inserted into the resource description contained in the notice.

The client application was built as a Java applet downloadable from the main UMVF web site. The user selects the resource he wishes to check. The applet then computes the MD5 digest of the resource and submits it to the description search engine hosted by Rennes. If a description related to the resource is found, the content of the description is displayed, in particular the version of the resource. If no description corresponding to the digest is found, it indicates that the resource is either corrupted or is not referenced by the UMVF.

3.3. The upload of notices in the Doccismef database

The notices are send by webmasters to the librarian team. They are transmitted by several ways: for example email or FTP. The notices are zipped in compressed files. They are processed either by a batch or by the use of a client application. Java classes are used to transform the UMVF notices in Cismef notices. They proceed by using two XSD files: UMVF.xsd and Cismef.xsd as references for the notices description. Other classes are used to import the XML data into the SQL database. The Java package can be used to export the notices from the Cismef Database to XML files.

3.4. Tests

Testing on the workflow application was performed by Archimed on the Windows platform and by Lille and Rennes on GNU-Linux.

The application was working without problems. The application was tested in real life in Lille by 9 teachers who submitted 34 resources and in Rennes by 31 teachers who submitted 99 resources. All the teachers was satisfied about the procedure and about the application. The two webmasters and the two librarians who participated in the test was very satisfied to. But we identified some errors done by authors or webmasters: here is the description of the most common errors.

- 80% of the type of resources was wrong except for the type "clinical case".
- 66% have wrong date information.
- 60% are not describing the right file format (i.e., html/text instead of pdf).
- 45% are lacking some reference numbers.
- 36% have error in the title.
- 12% have errors on author's names.

- 3% contain wrong link to the document.
- 3% have wrong information about the degree.

4. Discussion

This application improves the value of the UMVF repository by providing an easy way for all users, teachers and students to find a detailed description of a resource such as the dates of publication or revision, the authors, the content of the resource and the course to which it refers. Of more importance, it provides an easy way to check any resource from the UMVF to ascertain its quality and integrity, even if the resource is an old deprecated version. In such a case, the description provides a link to the accurate version. This functionality is very important because students use these resources in preparing for their examinations and certifications. The wide distribution of the resources across multiple medical schools renders it very difficult for the students to be certain of the validity of the information [7]. The ability to verify the content distinguishes the UMVF search engine from the usual search engines such as Google, constituting a critical improvement in this context.

Our application depends on only a small specific subset of the fields from the UMVF notice. As long as these fields are not changed, no modifications to the record in our application are needed. Changes to those fields which are outside our application continue to be solely the responsibility of the teams in Rouen and Rennes, and are reflected in our application with no further intervention. By contrast, changes to any of the specific fields which are used directly by our application require specific modification in our application also.

- For the teachers, this application might be of considerable help by providing management reports giving a quick and easy view of the status of all submissions they have made. They can readily distinguish the old from the new submissions, and the validated from the rejected ones.
- For the web master, the application provides a display of the status of all active files, permitting rapid and easy task management, as well as a search function for retrieving any resource according to its parameters, names, dates, or keywords.
- For both teachers and web masters, the application provides some communication facilities for informing the other of the status of the resources for which they are responsible. If more information must be sent between users, the application provides a link with a conventional e-mail system.
- For the indexation centers of Rouen and Rennes, this application is designed to help cope with the increasing flow of new resources created by all the medical school teachers of the French-speaking medical universities by providing validated base descriptions for their indexation work. At the same time, the application is designed to be as independent as possible from the description editor used for indexing. In general, changes and additions made to the UMVF notices by the indexers have no impact on our application; only if they involve the few specific fields used for reference between the two applications is it necessary to modify our application also.

We tried to decrease the number of errors, in the notices field by authors or webmaster, by using shareable controlled vocabulary [8]. But the testing shows it was not sufficient to avoid errors. Some items cannot be controlled by controlled vocabulary. The first way is to improve all the possible controls in the notice editor interface. The difficulties are to keep the interface simple and user friendly. Another solution will be to improve the training for teachers before they use the workflow. We will develop the two solutions. A first amelioration was possible with the help of local librarians. They were doing some pre-indexation tasks after the intervention of the webmaster but before sending the notices to the Indexation centres. A further version of the workflow application will take into account their participation in the process.

With respect to security, a limitation to the use of the MD5 digest keys is the fact that they are not encrypted. Consequently, the digest search engine must be implemented only on a certified server. An improvement would be to encrypt the digest incorporated in the notice by certificate assigned to the web masters. Such an improvement would require the building of a public key infrastructure (PKI) for the UMVF [10].

There are other initiatives for medical documents repositories like the Health Education Assets Library (HEAL) or the Medbiquitous project. The Health Education Assets Library (HEAL) is a digital library that provides freely accessible digital teaching resources of the highest quality that meet the needs of today's health sciences educators and learners. The publication process require to fill an online form. The Author has to give some very basic information about its submission. The first part of this process is similar to the one implemented in the UMVF process. The submissions are peer reviewed. The Medbiquitous project, drive an online community of practice that allows a diverse set of professionals to solve real-world problems in the design and implementation of healthcare e-learning by sharing knowledge and developing innovative solutions. The publication process in Medbiquitous lead on a classical e-mail submission "Submit your text article in Microsoft Word format and attach it to an email message" [11]. The submissions are reviewed by a committee.

Other organizations have objectives similar to those of the UMVF: for example, the IVIMEDS organization or the Health Sciences and Practice Subject Center.

The IVIMEDS organization describe itself as a major international collaboration created to meet the challenge facing medical education through innovative approaches which exploit developments in educational thinking and information and communication technologies. They do not release information about their publication process. The Health Sciences and Practice Subject Center is part of the Higher Education Academy. This is a UK-wide initiative supported by the four Higher Education Funding Councils in order to enhance the student learning experience. It works with Departments and individuals who support student learning in both academic and practice contexts. We do not had access to information about their publication process.

But there is fundamental differences between such repositories or organizations and the UMVF workflow process. The UMVF workflow process is designed to be compatible with both the single universities and the national project. If there was already a system, the old system is replaced with the

UMVF workflow. After being validated, each resource is put online by the local webmaster of the university on the local repository of the university. Only the notices are sent to the UMVF. The UMVF is providing a repository of notices with hypertext links to the media located in the repository of the single university. The indexation of the resources is done by a national team of librarians organized by the Rouen team. There are no global rules for reviewing the resources. Each university apply its own rules and the national team applies a metric, net scoring, to assess the quality of the resources [12].

On the language side, the publication process could be adapted for other languages than French but there is no short course plan.

5. Conclusion

The testing performed by Archimed, Rennes, Rouen and Lille verified the functionality and conformity with our specifications. However, the firsts deployments show that there was some variability in the quality of the manual indexation made directly by authors or webmasters. We have to improve the control in the indexation interface and to develop the training for teachers. At least we have to install the workflow in the other medical schools involved in UMVF.

REFERENCES

- [1] S.J. Darmoni, B. Thirion, M. Douyere, B. Dahamna, J. Weber, A quality-controlled health gateway to disseminate French pre-residency examination program teaching resources on the Internet. *Medinfo 2004*, 2004 (CD), p. 1566.
- [2] F. Mouglin, M. Cuggia, P. Le Beux, Development of an indexing search engine for the UMVF: proposal for an indexing method based on Dublin Core and XML, *Stud. Health Technol. Inform.* 95 (2003) 727-731.
- [3] <http://www.wfmc.org/> Workflow Management Coalition web site, 2005.
- [4] A.J. Menezes, P.C. Van Oorschot, S.A. Vanstone, Hash functions and data integrity, in: *Handbook of Applied Cryptography*, CRC Press, 2001, pp. 321-383 (Chapter 9).
- [5] D.A. Menascé, Security Performance, *IEEE Internet Computing*, vol. 7, No. 3, May/June 2003, pp. 84-87.
- [6] P. Beux, F. Duff, A. Fresnel, Y. Berland, R. Beuscart, A. Burgun, J.M. Brunetaud, G. Chatellier, S. Darmoni, R. Duvauferrier, M. Fieschi, P. Gillois, F. Guille, F. Kohler, D. Pagonis, B. Pouliquen, G. Soula, J. Weber, The French Virtual Medical University, *Stud. Health Technol. Inform.* 77 (2000) 554-562.
- [7] S.J. Darmoni, B. Dahamna, T.R. Roth-Berghofer, Related Articles, Seal of transparency heritage in the CISMef quality-controlled health gateway, *BMC Med. Inform. Decis. Mak.* 4 (1) (2004) 15, September 14.
- [8] Constructing a concise medical taxonomy, *J. Med. Libr. Assoc.* 93 (1) (2005) 121-123.
- [9] A. Fresnel, P. Jarno, A. Burgun, D. Delamarre, P. Denier, M. Cleret, C. Courtin, L.P. Seka, B. Pouliquen, L. Cleran, C. Riou, F. Leduff, H. Lesaux, R. Duvauferrier, P. Le Beux, A first evaluation of a pedagogical network for medical students at the University Hospital of Rennes, *Med. Inform. (Lond.)* 23 (3) (1998) 253-264, Jul-Sep.
- [10] M.R. Thompson, A. Essiari, S. Mudumbai, Certificate-based authorization policy in a PKI environment, *ACM Transact. Informat. Syst. Security (TISSEC)* 6 (4) (2003) 566-588.
- [11] Medbiquitous guideline for authors: http://meld.medbiq.org/about/guidelines_for_authors.htm.
- [12] CisMef Metric: <http://www.chu-rouen.fr/cismef/cismefeng.html>.