"WWW.MDTF.ORG": A World Wide Web Forum for Developing Open-Architecture, Freely Distributed, Digital Teaching File Software by Participant Consensus

Gregory L. Katzman, Danielle Morris, Jason Lauman, Chris Cochella, Patricia Goede, and H. Ric Harnsberger

Purpose: To foster a community supported evaluation processes for open-source digital teaching file (DTF) development and maintenance. The mechanisms used to support this process will include standard web browsers, web servers, forum software, and custom additions to the forum software to potentially enable a mediated voting protocol. The web server will also serve as a focal point for beta and release software distribution, which is the desired end-goal of this process. **Conclusions:** We foresee that *www.mdtf.org* will provide for widespread distribution of open source DTF software that will include function and interface design decisions from community participation on the website forums.

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AFTER 2 YEARS of development, our digital teaching file (DTF) software, such as the Radiology Digital Teaching File, image manipulation, and storage tools, have been designed. We have come to the realization that if all of these tools work together in a highly integrated and customizable software environment, more people would be apt to use them and possibly even develop new complimentary tools themselves. We have undergone alpha testing and are ready for the next step, beta testing, which normally involves sending the product outside the developers inner circle for real-world trial and exposure.

For this, we will take advantage of a method of beta testing called "usability testing," which has been summarized in a review by Bazman.¹ It is defined as "testing which attempts to find any human-factor problems." A better description is "testing the software from a users point of view." There have been three reports in the literature of medical projects that took advantage of public usability testing via the internet. Fong and Doyle² used internet distribution to develop software for evaluating renal function. Rubenstein et al³ provided for unrestricted public usability testing via an internet website during construction and refinement of their segmentation and three-dimensional radiological modeling software. Kovalerchuk et al⁴ developed radiologic consultation software to provide a second diagnostic opinion for questionable

cases, and made available experimental prototypes via the internet for testing and evaluation of design.

Our goal was to design a website that would provide an opportunity for scientists and physicians in the radiologic sciences to test and help develop our DTF software using the aforementioned usability testing model. We envision that such a site would provide for widespread distribution of our software around the world, ultimately producing a component suite of programs that have been designed by international consensus. With this innovative combination of creating open-architecture software, with development and modification based on international usability testing via internet distribution, we are confident that this product could become a cornerstone of medical information processing for years to come.

MATERIALS AND METHODS

The technology used to implement the DTF evaluation and distribution server includes standard open source software which is aligned with the academic goals of the DTF software developers. Apache Internet server (Apache Software Foundation, Forest Hill, MD), PHP middleware (Zend Technologies, Ramat Gan, Israel), MySQL relational database server (MySQL AB, Stockholm, Sweden), and Phorum (The Phorum Department Team, *www.phorum.org*) are the software packages that form the core of the three-tier server. These tools are supplemented with custom software and templates that will be folded back into the open-source software they are based on. A portion of this custom software includes a potential framework within which we can enable a voting process to resolve discussions occurring on the DTF evaluation site.

RESULTS

Using open-source software, it has been easy to establish a functioning website. The site *www.*

From the University of Utah Health Science Center, Electronic Medical Education Resource Group, Center for Advanced Medical Technologies, Salt Lake City, UT.

Address reprint requests to Gregory L. Katzman, MD, MA, University of Utah Health Science Center, Electronic Medical Education Resource Group, Center for Advanced Medical Technologies, 729 Arapleen Dr, Salt Lake City, UT 84108.

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mdtf.org now exists as a resource for physicians to use, and will continue to be developed as the needs of users are established.

At the time of this writing, offerings included a list of team members with an index to previous DTF publications (abstracts and papers), a frequently asked questions (FAQ) section, a description of the website purpose, and text descriptions of ongoing research. This latter section includes detailed descriptions of the four phases of software development we have planned, as well as our breakdown of what constitutes a case schema from which a DTF is built. A forum is also in place, allowing moderated discussions addressing questions that both arise from the WWW testing community directed to us, as well as questions from us regarding usability questions for the tester community at large.

CONCLUSIONS

To date, DTF needs have been addressed by academic groups in a severely divergent fashion. Proposed methodologies have included in-house generated software,^{5,6} as well as use of commercial proprietary software such as Microsoft (Redmond, WA) WinHelp⁷ and Adobe Acrobat (Adobe, San Jose, CA).^{8,9} However, a significant majority of DTF effort has been funneled into establishing WWW teaching files constructed with HTML,¹⁰⁻¹² which is a rapidly changing programming language that generates files viewable within a browser window on either a Macintosh, PC, or Unix platform, albeit slightly differently in overall appearance. Unfortunately, with the recent advent of hypertext markup language (HTML) version 4.0, many HTML instructions have been deprecated in favor of a new format called "cascading style sheets" (CSS). In fact, HTML has historically undergone significant changes with each new version.¹³ Thus, current radiology teaching files created with older HTML code may not be displayable by future browser software. Interestingly, it is this plasticity and flexibility of HTML that allows rapid adoption of technological advances, yet at the same time quickly outdates that which has gone before. Truly, HTML is a language best used for contemporaneous, but not archival, use.¹⁴

We must realize that as a larger number of academic radiology departments become filmless, there will be an ever-increasing and urgent need for methods to manipulate digital images directly

from the sources of origin for use in DTF. Eventually, no films will be generated at all, and image display (for any purpose) will rely entirely on electronic methods. Daily clinical case review, and long-term image storage and retrieval, will rely on an institution's picture archiving and communication system (PACS). However, for academic purposes, innovation of a DTF methodology which is easy, reliable, inexpensive, and conforms to a national standard is mandatory. Ideally, such a system should also be platform-independent, utilize open architecture, and be freely distributed.¹⁵

After 2 years of development, our DTF software such as the Radiology Digital Teaching File, image manipulation, and storage tools, have been designed. We have come to the realization that if all of these tools work together in a highly integrated and customizable software environment, more people would be apt to use them and possibly even develop new complimentary tools themselves. At this time, we have undergone alpha testing and are ready for the next step. Whereas alpha testing is performed by users within an organization that is developing software, beta testing is the last stage of testing and normally involves sending the product outside the developers inner circle for real-world exposure.

For this, we will take advantage of a method of beta testing called "usability testing," which has been summarized in a review by Bazman.¹ A new application may be developed which is exactly, 100%, in accordance with design specifications, yet is not fit for use as it may be too difficult or awkward to use, or it may be so complicated that the users don't want it or won't use it. This is especially true where the processes that drive the design of a new application are very complex. When a totally new or custom application is being developed, the coders themselves usually have no actual first-hand experience of the processes or rules that form the basis of the application being developed, and usually do not end up using the finished program. Additionally, the alpha test team, who may be the coders themselves, usually have minimal to no first-hand experience or the expert knowledge of the underlying logic/processes. Lastly, the success of new software will depend on how well it is received by the public: whether they like the application. If it is a high-quality development, the popularity of the software will depend on this usability. Thus, the benefits of having had

usability considerations included in the development of computer software are immense, and will provide a fresh viewpoint, as well as a realistic element to the testing process. Ultimately, this approach will yield better quality software, which is easier to use, more readily accepted by users, and shortens the learning curve for new users.

Faught¹⁶ has suggested that an appropriate tester to developer ratio may range upward towards 10:1, which could easily be achieved by WWW distribution. In fact, this method is common practice for business software usability testing. For example, S&S software (<http://www.ssoftware.com/>), who have provided software development since 1979, use the WWW to recruit both alpha and beta testers for their usability testing. A simple search engine query of the WWW along these lines reveals many sites encompassing societies, symposia, journals, books, companies, and consultants solely dedicated to this practice.

This has become common practice for business software development, eg, the most recent version of the Macintosh Operating System (OS X; Apple, Cupertino, CA) was offered from its WWW site (www.apple.com) for public beta testing, at a reduced operating system software cost to any participating tester. In contradistinction to this, medical software innovation has been driven by economics, resulting in mostly proprietary programs that have either been tested in-house or via a cadre of recruited physicians. However, there have been three reports in the literature of projects that took advantage of public usability testing via the internet. Fong and Doyle² utilized internet distribution to develop software for evaluating renal function. Rubenstein et al³ provided for unrestricted public usability testing via an internet website during construction and refinement of their segmentation and three-dimensional radiologic modeling software. Kovalerchuk et al⁴ developed radiologic consultation software to provide a second diagnostic opinion for questionable cases, and made available experimental prototypes via the internet for testing and evaluation of design.

We set out to design a website to provide an opportunity for scientists and physicians in the radiologic sciences to test and help develop our DTF software using the aforementioned usability testing model. We envisioned that such a site would provide for widespread distribution of our software around the world, ultimately producing a

component suite of programs that have been designed by international consensus. With this innovative combination of creating open-architecture software, with development and modification based on international usability testing via internet distribution, we are confident that this product could become a cornerstone of medical information processing for years to come.

At the time of this writing, our site included a list of team members with an index to previous DTF publications (abstracts and papers), a FAQ section, a description of the website purpose, and text descriptions of ongoing research. This latter section includes detailed descriptions of the four phases of software development we have planned, as well as our breakdown of what constitutes a case schema from which a DTF is built. A forum is in place, allowing moderated discussions addressing questions that both arise from the WWW testing community directed to us, as well as questions from us regarding usability questions for the tester community at large.

At full-functioning status, our goal for this website is to provide open moderated forums for consensus building while simultaneously fostering the communication between physicians and the programmers. Access and download options for all existing software modules will be provided, as well as technical support for the software and a FAQ section. This will include a formal registration process to allow group notification of forthcoming software upgrades. Since the goal is to assess for functionality and usability of the DTF software, feedback forms will be provided, and occasional surveys with voting may be offered to address specific questions from the programmers. News can also be posted demonstrating how others have utilized the software.

A physician liaison has been established (G.L.K.) to function as a moderator to field user questions and inquiries, guide discussions, create surveys, and collate survey data and remarks. With the other members of our team, he will also help to interpret the accumulated data. As the acting public liaison, and as an internal member of the onsite workgroup, he will provide seamless integration with the technical staff.

We envision, that after usability testing has been completed, we will have component software which has ultimately been designed by international consensus. The final goal we wish

to realize is to enable implementation of a standardized DTF model. We feel that our approach will provide an invaluable service to the entire radiologic community by assisting us to develop

DTF tools that can be distributed freely, perform similarly on different platforms, and incorporate functionality deemed necessary by radiologic users themselves.

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