

Trends and Technologies for Web 2.0 Application Design

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Abstract - In the paper Web 2.0 as a set of methods and techniques that encourage user participation and collaboration and result in the formation of communities that generate content or otherwise add value to a site is examined. The importance of these trends on sites and applications design is discussed. The emerging technologies and techniques and their impact on Rich Internet Application architecture are presented and they are used for educational portal designing.

Keywords – Web 2.0, technologies, Rich Internet Application, design, educational portal

I. WEB 2.0 APPLICATION CHARACTERISTICS

The new generation of the web is already the platform which is using for educational and business purposes [1], [2], [3]. As the penetration of high-speed and broadband Internet access increases, web technologies continue to evolve to deliver new user experiences and increased application utility. The main six ideas beside Web 2.0 are ideas about collaboration, contribution and community formation: individual production and user generated content, harness the power of the crowd, data on an epic scale, architecture of participation, network effects, and openness. They reflect on Web 2.0 application design and development. Web 2.0 applications possess new characteristics and they distinguish from previous generation of software by a wide number of principles. Web 2.0, applications are social and open and take full advantage of the network nature of the web as encourage active authoring and participation. Web 2.0 applications are service-oriented and allow creating, publishing, storing, sharing and remixing of data and information via blogs, wikis, audio/video recordings (podcasts/vidcasts), RSS syndication, tagging and social bookmarking, and creating social networks. Users are greatly facilitated by providing easy to use interfaces and mashup services.

Carefully analysis of recent state of Web 2.0 is indicative of the following application characteristics:

- Applications propose tools and services for authoring, automatically generation of permalinks, trackbacks, blogroll supporting (blog)
- RSS/Atom syndication, possibilities for tagging and bookmarking, aggregation and feed reading
- Multimedia sharing of audio/video files, presentations, images, podcasts, webcams
- Tools and services for building professional and social networks

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- Mashup services that pull together data from different sources to create new services
- Services for tracking and filtering content that keep track of, filter, analyse and allow search of the growing amounts of Web 2.0 content
- Collaborative reference works that are built using wiki-like software tools
- Replicate office-style software in the browser
- Web 2.0 services reach for a wider range of clients than the PC browser, such as mobile phones, PDAs, game consoles
- Web 2.0 applications are in perpetual beta, they are no longer released in version-based software packages, one version at a time, but are constantly refined and improved
- Achievements of high-level functionality of software development by using development frameworks enable the creation of Web 2.0 services in a very limited amount of time.

Training organizations are the most fertile grounds for encouraging the adoption of new technologies. Learners are interested in exploring new ideas and innovations, and educators are always on the lookout for new ways to engage their learners. Recently, the emerging technology as Rich Internet Applications has started to take off in the Web 2.0 space, gaining traction in education.

The aim of this paper is to discuss the Web 2.0 characteristics and technologies in order to be examined the main concepts at new generation web application design and development. The architecture of educational portal is developed according to the behaviour model, communication model and characteristics of Rich Internet Applications.

II. TECHNOLOGIES AND STANDARDS

One of the key drivers of the development of Web 2.0 applications is the emergence of a new generation of web related technologies and standards. Whereas in the past, software applications ran on the user's computer, handled by a desktop operating system, under the web as platform, umbrella software services are run within the actual window of the browser, communicating with the network and remote servers. Browser technology has moved on to a new stage in its development through Rich Internet Applications (RIA) [4]. Several technologies are vying for acceptance as the de facto standard way to build RIAs: Asynchronous JavaScript and XML (Ajax), Java applets, REpresentational State Transfer (REST) architecture style, microformats, open Application Programme Interface (API), Flash, Microsoft Silverlight [5], [6], [7], [8].

Ajax uses a specific range of technologies such as: HTML/XHTML - a standards-based way of presenting information within the browser, Cascading Style Sheets (CSS), Document Object Model (DOM)- a way of dynamically controlling the document, XML-data interchange and manipulation, XSLT - data interchange and manipulation, XMLHttpRequest – asynchronous data retrieval from the server, JavaScript – binding this technologies together.

Currently the main technology for delivering RIAs is Ajax, but there are some alternatives which are mainly based on Flash technology. Flash is still being used to deliver compelling content within the browser.

Ajax and Flash: With Ajax, only small amounts of information pass to and from the server once the page has first been loaded. This allows a portion of a webpage to be dynamically reloaded in real time and creates the impression of richer applications with the kind of responsive interfaces that are commonly found in desktop applications. The need for browsers to adhere to existing standards is therefore becoming an important issue. With high speed internet connections becoming the norm, multimedia is also becoming a big part of Web 2.0. Sites are embedding video and sound, as well as using Adobe Flash to create multimedia experiences.

REST: A further strand in the development of Web technology is the use of what are called lightweight or simplified programming models, which facilitate the creation of “loosely coupled” systems. They can be developed through usage of scripting languages such as Perl, Python, PHP and Ruby, and technologies such as RSS, Atom and a lightweight data-interchange format JavaScript Object Notation (JSON). REST is not a standard, but describes an approach for a client/server, stateless architecture whose most obvious manifestation is the Web and which provides a simple communications interface using XML and HTTP.

Microformats are widely used by web developers to embed semi-structured semantic information within an XHTML webpage. Information based on open data formats (a microformat) is buried within certain XHTML tags or attributes and it is not used by the browser for display or layout purposes but it can be picked up by applications such as search engines.

API provides a mechanism for programmers to make use of the functionality of a set of modules without having access to the source code. An API that doesn't require the programmer to license or pay royalties is often described as open. Such open APIs have helped Web 2.0 services develop rapidly and have facilitated the creation of mashups of data from various sources.

III. THE RIA BEHAVIOR AND COMMUNICATION MODELS

The RIA behavior model represents the principle elements and its performance and management as it is shown in Figure 1. It presents a few behavioral outcomes that are relevant in the context of an interaction between a human user and a RIA. At the highest level, the model illustrates three major aspects, each of which influences application performance: the

application's design and usage environment, the user's expectations and behavior, and the application's behavior when used.

If a Web browser is the simplest form of client engine, then the black arrows trace the flow of a traditional web page download. The user *clicks* on a link in the browser, the browser sends *requests* to one or more servers. Servers *respond to client requests*, and when enough of the requested *content* arrives on the client (in the browser cache), the browser displays it and the user can *view it*. The user's experience of response time is the elapsed time of the entire process *from click to view*. In a traditional synchronous web application, this process repeats several times, because applications usually require an exchange of information.

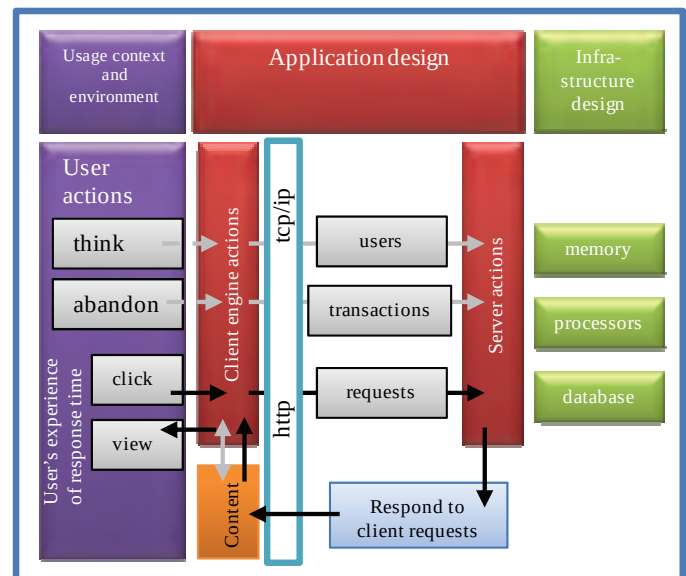


Fig. 1. The RIA Behavior Model

Servers must field requests concurrently from many users. No matter how powerful the server, every concurrent user consumes a small share of the server's resources: memory, processor, and database. Web servers can respond rapidly to stateless requests for information from many concurrent users, making catalog browsing a relatively fast and efficient activity. The number of concurrent transactions—server interactions that update a customer's stored information—plays a critical role in determining server performance.

In the model, the grey arrows and the boxes labeled *Users* and *Transactions* indicate that server performance is strongly influenced by these concurrency factors. The RIAs (as indicated by the dotted lines in Figure 1) give application designers the flexibility to design applications that attempt to take account of such behavioral variables.

Although implementations differ, all RIAs introduce an intermediate layer of logic— a client-side engine—between the user and the web server. Downloaded at the start of the session, the engine handles display changes and communicates with the server (Figure 2). Adding this layer allows developers to build web applications with characteristics described as “between the fat but rich client/server model and the thin but poor web based UI model” [9].

Adding a client-side engine does not prevent an application from implementing the traditional synchronous communication style. But it also allows the user's interaction with the application to happen asynchronously—independent of communication with the server. In a RIA: information can be fetched from a server in anticipation of the user's input; in response to an input, the screen can be updated incrementally instead of all at once; multiple user inputs can be validated and accumulated on the client before being sent to the server; responses to some user inputs can be generated without communicating with the server; processing previously handled by servers can be offloaded to the client desktop.

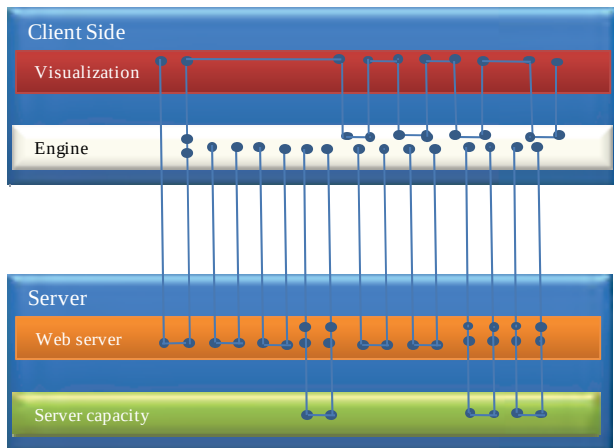


Fig. 2. The communication model of a RIA

IV. EDUCATIONAL PORTAL DESIGN

Web 2.0 proposes technologies with profound potential for inducing change in the education sector. In this, the possible realms of learning to be opened up by the catalytic effects of Web 2.0 technologies are attractive, allowing greater student independence and autonomy, greater collaboration, and increased pedagogic efficiency [10], [11], [12].

There are a number of ways to incorporate RIAs into the curriculum of training organizations. RIAs can capture learners' imagination with some of the same technologies from applications such as: Facebook, YouTube, and Ning. Another key benefit of RIAs is providing flexibility to learners and enhancing their workflow both inside and outside the classroom. The biggest benefit of RIAs inside the classroom is the ability to augment current teaching techniques.

With RIA technologies, educators not only can provide a rich, intuitive interface but also can give learners full control over data. Because RIAs can provide real time audio and video capability, the chance to enhance collaboration and classroom participation is significant – in form of distance learning, blended learning or learning in classroom. RIAs also enable a better workflow for learners – working on projects at training organization laboratory, at library or at home their work is stored on a server somewhere so that learners can access it from any location. Also, RIA technologies allow in-browser, customizable replacements of Word, Excel, and other desktop applications. RIAs can also be

deployed for multiple devices: the browser, the laptop, and even some limited functionality on the mobile phone which giving learners a flexible work solution means that they will be encouraged to interact and work on their projects.

There are many unresolved problems and issues in Web 2.0 and its usage in education. These include: tools and services for learning resources creation and modification by educators and students; data ownership; control over content; appropriate pedagogies for use with Web 2.0; how to assess material that may be collectively created and that is often open to ongoing change; how to organize learning environment [13], [14].

The right choice of tools and services is important for educators in order to organize and manage the learning process. Therefore the functional architecture of educational portal based on Web 2.0 concepts is developed and its areas are presented in Figure 3:

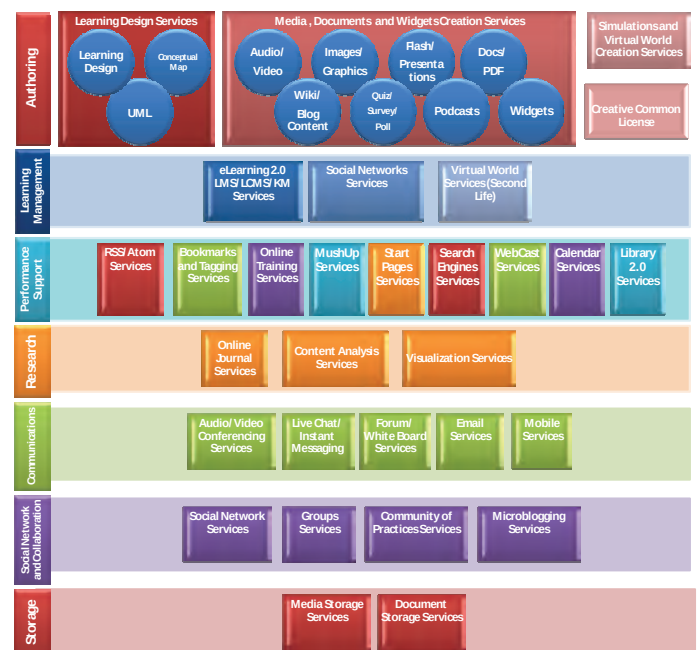


Fig. 3. Functional Architecture of Educational Portal

1. **Authoring Area:** Learning design tools and services; media, documents and widgets creation tools and services; simulations and virtual world creation tools and services, Creative Common License for author rights protection
2. **Learning Management Area:** eLearning 2.0 system; Social networks which can be used for learning management; virtual world services like Second Life
3. **Performance Support Area:** This area I organize as a Personal Learning Environment for Educators. Educators use tools and services to receive information, expert opinion, lifelong learning
4. **Research Area:** Tools and services for reading, writing, publishing, analyzing and visualizing the research topics
5. **Communication Area:** different possibilities for synchronous and asynchronous communications
6. **Social Network and Collaboration Area:** for networking building and collaboration
7. **Storage Area:** Web proposes many possibilities for media and document storage.

V. RIA DESIGN AND DEVELOPMENT TOOLKITS AND FRAMEWORKS

There are several open source and commercial JavaScript and Ajax toolkits available to make creating Web 2.0 applications faster and easier [15], by abstracting browser differences and providing base functions for event handling, Ajax interactions, data binding, graphic effects as well as rich, customizable user interface components:

- Google Web Toolkit - <http://code.google.com/webtoolkit/> - open source software
- Yahoo User Interface Library - <http://developer.yahoo.com/yui/> - free for use
- Dojo - <http://www.dojotoolkit.org/> - open source DHTML toolkit
- Prototype - <http://www.prototypejs.org/> - open source
- Open Rico- <http://openrico.org/> - open source
- TIBCO General Interface - http://www.tibco.com/software/rich_internet_application/default.jsp - open source
- Zimbra Kabuki AJAX Toolkit - http://www.zimbra.com/community/kabuki_ajax_toolkit_download.html - open source edition
- IT Mill Toolkit - open source and commercial license <http://www.itmill.com/itmill-toolkit/>
- ZK - <http://www.zkoss.org/> - open source
- Echo - <http://echo.nextapp.com/site/echo2> - open source licensed under the Mozilla Public License
- Adobe Flex 2 <http://www.adobe.com/products/flex/> - 30 days trial
- Ruby on Rails – open source framework <http://www.rubyonrails.org/>

Also, in addition to toolkits, there are Integrated Development Environments for Web 2.0 applications creation: Microsoft's ASP.NET AJAX - free framework for developing Web 2.0 applications; Eclipse – Ajax tooling framework; IBM's Rational Web Developer.

VI. CONCLUSION

In the paper the Web 2.0 software characteristics are analyzed. The technologies and architecture of RIA applications are explored. The findings lead to the tremendous creativity that can be put into RIAs which is a fantastic fit for educators who want to push the envelope in how they arrange activities and present content to their learners. The designed functional architecture of an educational portal is presented. The next step is its development via the RIA technologies using Ruby on Rails open source web framework, Apache server and MySQL database. The portal is intended to offer tools and services for the bachelor degree students on the subject Internet Technologies.

Apart from technological developments there are three significant challenges for education: (1) The crowd, and its power, will become more important as the web facilitates new communities and groups; (2) The growth in user- or self-generated content, will challenge conventional thinking on who exactly does things, and who has knowledge; (3) There are profound intellectual property debates ahead as individuals, the public realm and corporations clash over ownership of the huge amounts of data that Web 2.0 is generating and the new ways of aggregating and processing it.

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