Moving from Folksonomies to Taxonomies: Using the Social Web and 3D to Build an Unlimited Semantic Ontology

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Abstract

The Semantic Web was introduced in 1999 as a method of interrelating information to help computers derive conclusions based on the links between data. With the rising popularity of Social Networks though, unconnected pieces of information have only chaotically increased instead of becoming parts of well-organised Taxonomies.

In this paper, we suggest a system which will take advantage of the Social Web and put it to work so that it will operate under the common cause of categorising old and new data into an unlimited Semantic Ontology. This ontology will be created gradually and ever-changing, like a versatile encyclopaedia of information compiled from interconnected data. With the addition of a 3D Web interface on top of the ontology management mechanisms, the entire experience will become more user friendly, providing graphical presentation of all opinions and interpretations in a clear and comparable manner.

Keywords: **Semantic Web, Social Networks, 3D, Information Visualisation, Knowledge Management.**

1. Introduction

We live in the Information Era, where knowledge is everything and everywhere. The proper management of knowledge presupposes the existence of mechanisms for organising information, in order to match the appropriate pieces together. When the Internet came along, it offered users the ability of having access to many different types of electronic data. Unfortunately, these data are still mostly uncategorised and the human mind simply cannot absorb and process the increasingly huge amount of information available. This is the reason why computers are utilised to gather and present information in a more streamlined manner, so that people are able to browse through the findings in a faster and more convenient way.

XML and all the technologies that are based on it, like the Semantic Web [1], provide the facilities for electronic devices, even of different nature, to communicate with each other and exchange data in a commonly acceptable way. This is really useful, especially when it comes to making machines responsible for information gathering and the delivery of coherent results which a human can understand and rely upon. The Semantic Web is already trying to organise information into standardised structures called Ontologies [2]. This will gradually create a common ground for all topics, making information sharing easier and more automated.

Social Networks can benefit from the use of Semantic Ontologies to improve their simple, yet unsophisticated, method of tagging which is based on keywords rather than logical concepts. Adding Semantics may require more time than plain old word tagging, but the long-term gains can prove to be profitable in the quality of search results and in data categorisation.

With the number of 3D-based virtual communities increasing every day, both for Social and Gaming worlds, combining all the aforementioned technologies can result into a powerful online tool which will offer ease of use and meaningful search results [3].

2. Background and Related Work

At the original proposal of the World Wide Web in 1989 [4], most could not predict that it would become as widespread as it eventually did. Despite initial expectations, the Web has turned into a killer app of the Internet, gradually taking over the roles of other applications like E-mail, Usenet Newsgroups and IRC.

While the number of websites and webpages kept rising, it became impossible for a human to memorise all the available Web addresses or manually search through online data for specific information. That is the reason why Search Engines were invented, aiming to provide faster searching through a large amount of webpages based on requested keywords. After many attempts, and a variety of algorithms for page ranking, new age Search Engines are beginning to adopt the Semantic Ontology model to categorise their data in order to provide faster and more relevant results.

2.1. Search Engines and the Semantic Web

Computers are programmed by people to respond in a predefined way to specific actions. Artificial intelligence scientists have made several attempts to make computers come up with original ideas but, up to this point, it has not been achieved. Given the fact that computer applications can only follow the rules programmed into them (or the rules that those rules produce), they cannot yet cross the line from computing to improvising.

Since Search Engines are computer applications too, their search results are bound to be calculated and precise, based on mathematical formulae for text searching. This way, results may match the given words or phrases, but the meaning is totally lost. A search for the word "apple" will return many links to webpages and pictures of apple trees, as well as Apple computers, among a lot of other things. Researchers suggest [5] that in the circumstance of the results being too many, users usually go through the first few pages and then either accept what they found as the truth or just give up.

The most practical method to deal with this problem is to help the computer "understand" what each piece of information "means", by using the relations between interconnected objects. The Semantic Web project is trying to address this issue by grouping information into Ontologies, which are logically organised datasets, a formal and well defined version of Taxonomies [6]. This means a user could specifically search for the fruit called apple, retrieving more relevant results. A few Semantic Web based Search Engines already exist [7, 8].

Computer users have grown accustomed to the habit of text search engines where they must type in keywords which they believe are related to their search. Those keywords are then matched to the index of the engine by using proprietary algorithms and a result list is produced, usually ordered by relevance or link popularity.

Semantic Web based search engines are trying to redefine this procedure. They may still be asking the user to type in text but they match those keywords to ontology items thus making results more logically relevant, rather than just plain keyword relevance [9]. This is feasible because ontologies organise items based on logical connections derived from the item meaning.

As time passes, ontology standardisation will play an increasingly significant role in information categorisation and exchange. Scientists will be able to compare their research with others faster and in great detail due to the specific nature of ontology definitions. All individuals can benefit from the advantages of Semantic annotation, for example while searching for music that sounds like their favourite band or for a movie to watch based on which films they have enjoyed so far [10]. It is only a matter of presenting the idea of well-organised data to the Social Web communities in a useful and inviting way.

2.2. The power of Social Networks

Soon after the Web became available to the public in the early 1990s, many users became interested into creating their own personal website to present themselves, their businesses or their interests. Certain companies begun giving away size-limited Web space for free on their servers and in exchange they placed advertisements on top of each webpage. This way, Web "citizens" began interacting with each other, linking their websites, exchanging virtual "awards" and comments in electronic "guestbooks", as well as publishing their personal thoughts, ideas, pictures or even poems and passages. Separated from the commercial websites, the personal websites had a life of their own, either organised in communities or independently posting articles and news of interest to this new "global village".

Near the end of the 1990s, users started calling their personal websites "blogs", a contraction of the words "Web" and "log", leading to the creation of a new trend in the Web culture [11]. This eventually lead to the creation of the first "online social networks" in the early 2000s, a term also popularised as "Web 2.0" by Tim O'Reilly of O'Reilly Media [12]. Social networks reused all the well-known technologies of the Web but, instead of offering free Web space, they prompted users to upload all their information and material inside a standardised personal profile page.

Friendster, MySpace, Facebook, LinkedIn and other well known Social Web giants became increasingly popular because they responded to the need of people to keep in touch with their friends or acquaintances and participate into activities together, like groups or games. Many companies, like YouTube, Flickr, Delicious and others, followed the Social paradigm by adding mechanisms to increase community participation and cooperation.

What all of the above websites have in common is that they categorise their data by using Folksonomies. This term was coined up around 2004 [13] from the words folks and taxonomy and basically defines the method of using keywords to describe the content of a data object. Blog articles, images, video and sound files stored all over the Web have been annotated using the words that uploaders chose to describe their data. Those words might or might not be related to the content, depending on the perception (or mood) of each uploader. It may be an extremely fast way to annotate data but, due to the lack of standards, many tags are vague, misspelled or simply wrong.

When the Social Web eventually merges with the Semantic Web, the users will be the first to benefit because, after the Semantics have been agreed upon, data sharing will be seamless and instant. It may take longer to annotate data than plain old keywords, but visualisation techniques can be used to speed up the process.

2.3. 3D environments and virtual worlds

With the rise of the computer age in mid 20th century, every type of business tried to get the best out of the new technological achievements. Even though at first computers only had text command interfaces, they eventually became able to present graphics. These graphics were initially plain, but as computer capabilities increased, so did the complexity of the designs.

The computer game industry has taken advantage of 3D graphics and moved from classic point-and-click games to 3D gaming. From first-person shooters to massively multiplayer online role-playing games, 3D graphics improve the gaming experience by offering a more realistic gameplay to the users.

With the Social Networking niche in mind, companies decided to combine 3D gaming environments with online communities, such as Second Life, Active Worlds and IMVU, among others. These programs, though, require the users to download extra Windows applications, which execute separately from the Web browser in order to access the 3D environment. This fact not only prevents application mobility but also isolates the actual program from the Web realm, leaving only the account management on the company website.

A notable attempt to combine browser based 3D graphics with a Social Network was Google "Lively", which was launched, popularised and shut down in 2008. Lively used Flash, as well as a proprietary plug-in, in order to execute inside the browser and the final result was a fully in-browser 3D experience. Despite its initial success, Google decided to discontinue "Lively" shortly after its inauguration to focus more on their core search [14]. A similar Flash application called "Smeet" still exists, created by a German company.

As far as 3D search engines are concerned, there have only been a few attempts. In 2005, a company called "INOZON" announced [15] that they would be creating the first 3D based search engine, running inside a browser, but eventually the project fell apart. Another example was "Ergo" by Invu, launched as beta in 2007, running in an application outside the browser, offering a visual environment for searching information [16].

Although all these attempts are recent, a Web language to express 3D graphics started to be formed as early as 1994 and was called VRML (Virtual Reality Modelling Language). Since that time, it managed to become a standard and reached version 2.0, before being succeeded by X3D.

X3D is an XML based language which aims to popularise a file format to display 3D graphics by using XML syntax [17]. This makes 3D graphics ideal to parse and present inside browsers or to use with any type of XML related API. At this moment, though, X3D is not widely used and its commercial utilisation is limited. Also, Web browsers require extra add-ons to display the X3D environment. Being standardised with HTML5, the latest version of HTML, will help this format to gradually gain more recognition, while the X3DOM [18] project is already trying to bypass the need of a plug-in.

HTML5 will also bring instant embedded support of WebGL, a language based on JavaScript which offers in-browser interactive 3D graphics, as well as CSS3 which will also offer 3D transformations. The basic aim of HTML5 is to be able to run in all types of devices and support the creation of Web applications without the need of extra plug-ins. This will bring the Web to an entirely new level.

3. The future Web: Social, Semantic and 3D

What the Web needs now is a new idea, to make users feel that all these advancements can indeed improve the current status quo.

Introducing 3D visualisation techniques to the Social Web would be a start but by itself it would only appear like a "cool" looking improvement of the graphics. There has to be essential change in the way we perceive data annotation and information acquisition. The Social community is a power strong enough to fill websites with a plethora of multimedia files gathered in many different ways. The users only need to become accustomed to a new method of tagging data, in order to make them part of a Semantic Ontology.

This is why we propose the creation of a system that will have the properties of the Social Web, but with a 3D Web interface on top and a Semantic Ontology behind it. It will be a new age Web application, merging the aforementioned technologies into a 3D Social community, which will constantly be improving an underlying, unlimited, Semantic Ontology.

3.1. Creating an information driven community

The proposed system will have a search engine which will not only check indexed keywords for similarities to a given input, but will also classify data to specific categories of an unlimited catalogue. This catalogue will be created gradually as users add new multimedia objects or change the already existing ones. Some organisations, such as Wikipedia, Dmoz or Open Source Software communities, have managed to maintain quite a high level of data quality, even though they are not always edited by professionals, but by earnest individuals who dedicate their time to adding and correcting the website material.

The users of this system will enjoy the advantages of a 3D Social community, such as 3D avatars and personalised virtual "lounges", and at the same time will contribute to the creation of an infinite and global source of knowledge. This way, not only they will be able to participate into Social Networking activities but they will also play an important role into rating the quality of the information available in the system by voting up or down additions and changes based on the correctness of the submission.

This participation will make the Web community more active and raise awareness against spam and phishing attempts because data will be immediately comparable due to the nature of ontology objects. Users

will be required to make all changes and additions using their real name which will radically reduce the cases of "trolling" (i.e. uploading inflammatory or off-topic data).

Using an overall reputation based scheme, the level of user access to the system will be altered depending on how their additions and changes are ranked. Thus, material which contains mistakes or is miscategorised will be voted down and gradually replaced by correct ones, while at the same time the overall reputation status of the uploader will decrease, restricting their access to website features.

3.2. Making data management user friendly

The most interesting factor of the system is that the users do not have to possess any type of Semantic Web or XML knowledge in order to use it. The 3D Web interface will help them to add, change or search for specific website objects by creating new compositions. In order to manage or look for data, users will select 3D objects and connect them to each other, thus graphically compose what they are adding or seeking.

An example connection of three objects is presented in Figure 1. More specifically it has been composed to look for a "Person" who is working for a "Business" in a specific "Location".

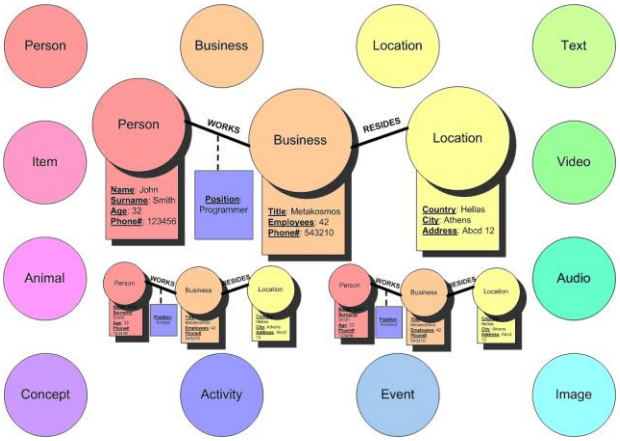

Figure 1: Draft layout of a query in a custom user interface

We call this method "Semantic Synthesis", from the Hellenic word "synthesis" which means "composition". It is interesting to note that the term "Semantic Synthesis" was initially used by Igor' Mel'cuk in 1965 [19], for his Meaning Text Theory which was the suggestion of linking words of different languages together, based on their meaning (i.e. semantically). In our system the objects will be semantically connected to compose (synthesise) specific queries or additions. The associations between the objects will be assigned roles, based on a list of supported role objects for each relation.

In addition to the connection roles, extra information may be provided for each selected item, in a menu offering a choice of specific properties available for each object. As soon as the query or addition has been synthesised, there will be an option to either add it or search for it. Figure 1 also shows possible search results below the synthesised query.

The positive factor of showing results this way is that they can be selected and then further explored with additional queries. Specifically designed mechanisms will help the user quickly shift through the results. Some are currently being evaluated based on their performance for a variety of different queries. The whole search experience must be fast and always produce relevant results which means that the total time spent and the quality of the results are the most important factors.

To create these mechanisms, information must be viewed not only as words and phrases, but as objects which are all parts of the same unified system. That is where the 3D Web interface will come in handy, to give users a look and feel of actually connecting objects.

Ultimately, the user may search through the information provided by our system and then explore links to external websites for extra references, such as images, videos and additional, not yet stored, material.

3.3. Social Semantics drawbacks

Web citizens have been tagging online data sources for many years now. Apart from the obvious powerful virtual workforce of collective intelligence they comprise [20, 21], there are also certain negative aspects to it. The current drawbacks of Social Semantics are summed up by three basic factors of human nature: responsibility, credibility and objectivity.

When people publish data on the Internet, they do not always take the time to label and organise them based on the existing standards for each category, thus making their meaning vague for a computer. This lack of responsibility can be avoided by utilising predefined methods for adding and manipulating objects so that they carry at least some basic annotation, which will be aided by using visual objects and Semantic Synthesis.

Even if this problem is surpassed, no one can guarantee that the categories and relations the user has selected are appropriate for that object, because not everyone is a field expert on everything they post online. That is why users will have the ability of voting additions up or down, which will affect the overall reputation of the uploader appropriately.

Finally, the biggest problem of all is objectivity. Even for an organised consortium of scientists and field experts it would be difficult to agree on a common methodology for characterising every possible piece of information. The only way to prevent the debates from reaching a total deadlock is to try and present all opinions in a very specific and comparable way, so that each researcher can then determine what applies to their specific case.

Philosophy and Sociology will play an important role in the definition of most data categories (e.g. ideas and concepts) which are unsubstantial by nature. Gradually, all views and suggestions will be synthesised and depicted, allowing users and researchers to compare them side by side in a more streamlined manner.

4. Metakosmos

All of the above will be joined together in a system called "Metakosmos", from the Hellenic words "meta", which means "after", and "kosmos", which means "world" or "universe". The name reflects the ultimate purpose of the system, which is to create a graphical virtual world of organised information about the entire real world.

4.1. Social Knowledge Management

Metakosmos will be a 3D Social Web community that will store its information by taking advantage of Semantic Web Ontologies. The system will have two types of users: unregistered (visitors) and registered (members). Visitors will be only allowed to use the search engine, without being able to adjust the user interface or participate to the addition, categorisation or correction of data. Members will be able to use the website to its full extend.

Additionally, the members will be able to edit their user interface on the website by choosing which items should appear at their home screen, also known as their "lounge". They will select those items by searching through the available categories offered by the website or by adding new ones. They will also be able to add new items to the system, rearrange existing data or even correct mistakes that may exist such as, for example, object miscategorisation or misspelling.

Collecting consistent data is essential for any search engine, especially for one that needs to store them inside an ontology. Members will have to correctly synthesise the data, based on their understanding, in order to add them to the system in the appropriate categories. Other members with better understanding or expertise on a domain will be able to suggest corrections, if needed.

Members that offer a lot to the website, either by adding new material or by correcting existing items, will receive an increased reputation status which will allow them to influence the system faster. Clearly, members that do not cooperate respectfully will receive a decrease of their reputation status, giving them less and less access in influencing the system.

All the user interaction will bring out the social aspect of the system, uniting the members under the common cause of keeping everything organised and as accurate as possible. The additions or changes which are well defined and correctly categorised will be voted up by the members, thus increasing the overall reputation status of the person who synthesised them. In contrast to this, constant mistakes and sloppiness will cause members to vote items down, decreasing the reputation of the person responsible.

Five reputation levels will be used: Ignored (0%), Trainee (25%), Notable (50%), Popular (75%) and Perfect (100%). Newly registered users will start as Trainees and then, depending on how well they adjust, their reputation will increase or drop. If their additions or changes are constantly voted down they will eventually reach the Ignored status which would mean that their new additions will be automatically pre-voted down and they will also be unable to make any changes to the system.

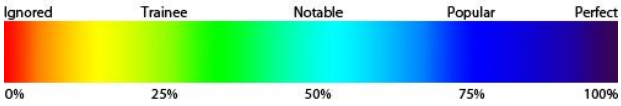

Figure 2: The five suggested reputation levels

The Metakosmos system will aim to provide simplicity to all users, whether they are technology amateurs or experts, as well as offer scalable complexity based on customisable options, while maintaining the same effective search experience despite of the settings.

4.2. Synthesising, integrating and sharing

By reintroducing the term of "Semantic Synthesis", users will be called to select predefined objects, connect them in a way they consider meaningful, add literal parameter information and finally search for matching results stored in the system. Additionally, registered members will be able to synthesise additions or any needed changes to the system. All of the syntheses will be Semantic Web based, even though the website users will only see the 3D visualisation representation.

Metakosmos will aim to set certain standards which other developers will be able to follow so as to interact externally with the system or to implement additional capabilities for the user interface. Currently set as future work, is creating the mechanisms to integrate Semantic Syntheses from other websites, as well as to share local syntheses with external Web applications by exporting them in an appropriate form.

As time passes, more and more websites will appreciate the advantages of using Semantic Ontologies, making data sharing and integration simpler and instant. Semantic annotation will gradually replace the keyword cloud tagging of Folksonomies, allowing increased access to data of all types and formats.

4.3. Adding a 3D User Interface

In order to make Semantic annotation easier and more straightforward, 3D visualisation elements will be used to depict the various Semantic objects that comprise each synthesis. Usability will be an important factor of this new age 3D community, in order for it to get accepted by the general public and integrated into everyday life. It has to combine simplicity with scalable complexity, based on custom options, while maintaining the same effective search experience for all users.

To achieve this, an extra layer of graphics is added on top of text searching, making search queries visually accurate and, as a result, retrieving more relevant search results. With the help of the underlying Semantic Web ontology, as well as with the introduction of 3D graphics, users will be able to query content both textually and visually, depending on their personal preferences and the

nature of their search. This way, they will be able to retrieve highly relevant results, which can be presented in many different forms.

With the upcoming official arrival of HTML5 [22] and the constantly increasing improvements of Web 3D graphics like X3D, X3DOM, WebGL and CSS3, the Metakosmos system will obtain its final form and gain its place among the first 3D Social Web communities, while at the same time participate in the storing and categorisation of global knowledge in a large scale.

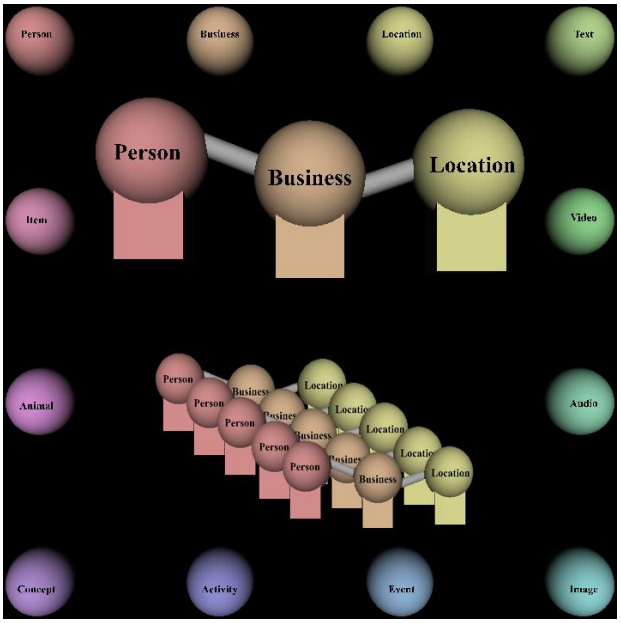

Figure 3: Mock-up user interface compiled in X3D

Conclusions and Future work

When the Metakosmos PhD thesis is complete, the first prototype will be launched online in order to offer users a preliminary beta testing of the system.

The initial version will be a visually searchable and updatable catalogue which will aim to produce useful and relevant results as quickly and as accurately as possible. This means minimising unsolicited advertisements, preventing misinformation and yet presenting all possible views of each subject, both concisely and thoroughly, based on the personal preferences each user sets. Gradually, more and more users and websites will be able to create and exchange their information syntheses and come up with ways to merge and unify new and old data as efficiently as possible.

Eventually, new functionalities will be added to the system which will give members increased access in affecting their user interface themes, thus making searching and editing further adjustable. Additionally, Web Services will be launched to make information integration and sharing more automated for external applications.

The merging of the Social Web with the Semantic Web is an inevitable advancement which will lead to increased information organisation and universally useful data mining. The addition of the 3D Web interface on top of the ontology management mechanisms provides an extra level of simplicity in order to make the experience more user-friendly. Although keyword search will be also available, the proposed visual search environment is only a glimpse of what the future of the Web holds.

References

[1] T. Berners-Lee, et al., "The Semantic Web," Scientific American, vol. 279, 2001.

[2] H.P. Alesso and C.F. Smith, Thinking on the Web: Berners-Lee, Gödel & Turing, John Wiley & Sons, 2006.

[3] V. Geroimenko and C. Chen, Visualizing the Semantic Web: XML-based Internet and information visualization, Springer, 2006

[4] World Wide Web CERN Proposal: http://www.w3.org/History/1989/proposal.html

[5] iProspect, "Search Engine User Attitudes," 2004; http://www.iprospect.com/premiumPDFs/iProspectSurveyComplete.pdf.

[6] W. Pidcock and M. Uschold, "What are the differences between a vocabulary, a taxonomy, a thesaurus, an ontology, and a meta-model?," 2003; http://www.metamodel.com/article.php?story=20030115211223271.

[7] Swoogle: http://swoogle.umbc.edu/

[8] Hakia: http://www.hakia.com/

[9] D. Li, et al., "Swoogle: a search and metadata engine for the semantic web," ACM, 2004

[10] Jinni: http://www.jinni.com/

[11] J. Wortham, "After 10 Years of Blogs, the Future's Brighter Than Ever," 2007; http://www.wired.com/entertainment/theweb/news/2007/12/blog_anniversary.

[12] T. O'Reilly, "What Is Web 2.0 - Design Patterns and Business Models for the Next Generation of Software," http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html, 2005

[13] Folksonomy: http://vanderwal.net/folksonomy.html

[14] Lively: http://googleblog.blogspot.com/2008/11/lively-no-more.html

[15] INOZON: http://prweb.com/releases/2005/02/prweb211778.htm

[16] Invu: http://www.invu.net/

[17] V. Geroimenko and C. Chen, Visualizing information using SVG and X3D : XML-based technologies for the XML-based Web, Springer, 2005, p. xiv, 298 p.

[18] X3DOM: http://www.x3dom.org/

[19] A.K. Zolkovskij and I.A. Mel'cuk, "On a possible method and instruments for semantic synthesis of Texts," Nauchno-texnicheskaja informacija, vol. 1, no. 6, 1965

[20] H. Halpin, et al., "The complex dynamics of collaborative tagging," ACM, 2007, pp. 211-220.

[21] V. Robu, et al., "Emergence of consensus and shared vocabularies in collaborative tagging systems," ACM Trans. Web, vol. 3, no. 4, 2009, pp. 1-34; DOI 10.1145/1594173.1594176.

[22] HTML5: http://dev.w3.org/html5/spec/spec.html