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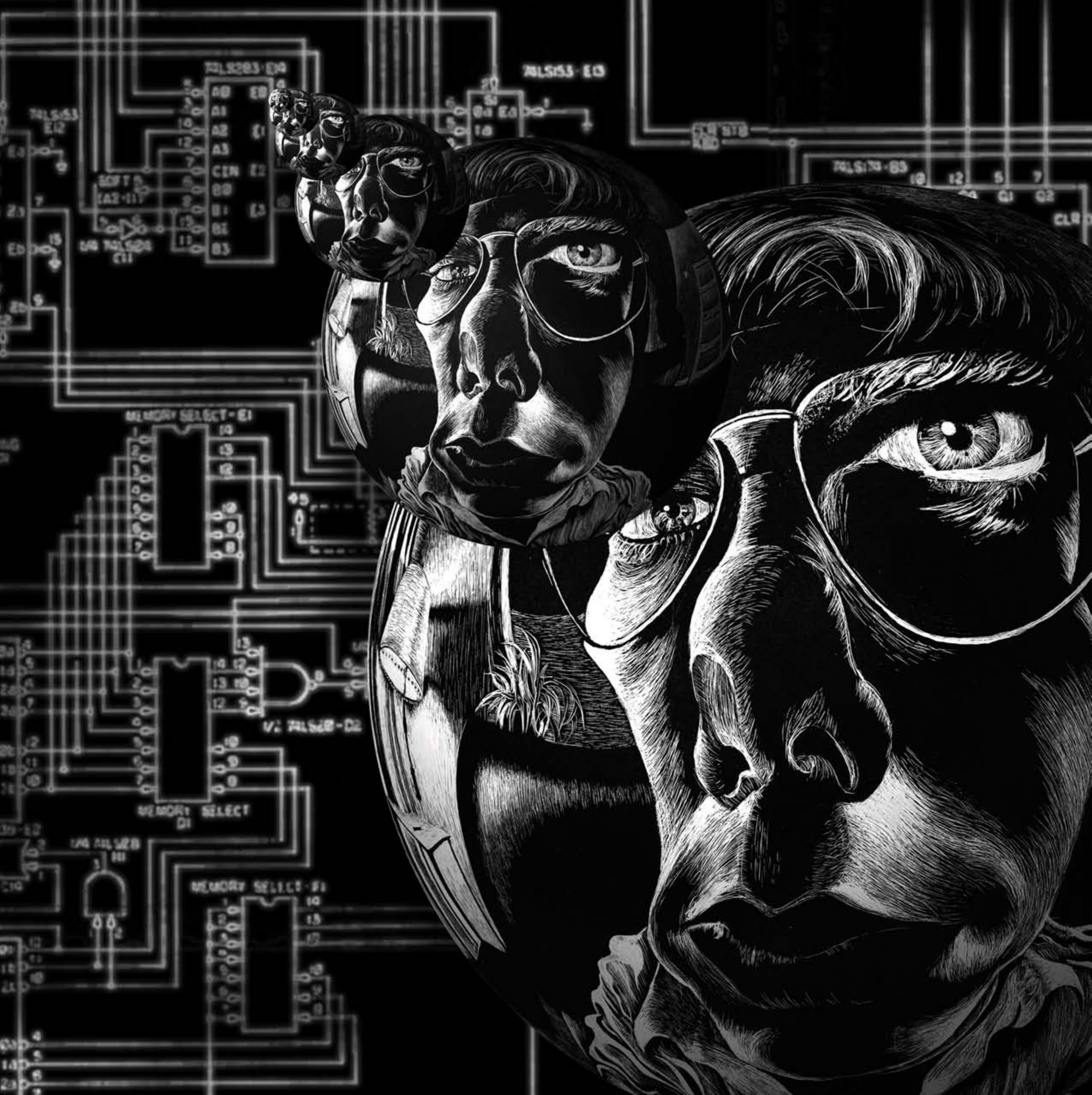

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Compounding the Results: The Integration of Virtual Worlds With the Semantic Web

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Abstract

Over the past 20 years, governmental use of Web-base information and technologies has continually expanded taking advantage of the Web's vast, ever-expanding volumes of browser-accessible information. Now, it infuses two new technologies, the first one espousing a world where semantic-powered applications become knowledgeable assistants for Web users. The second new technology takes a perceivably flat two-dimensional approach to presenting current Web-content and adds a three-dimensional perspective to the presentation. Welcome to the Semantic Web as seen through the eyes of a Virtual World participant, an environment where Web users no longer are browsing for information that is largely static, where Web users interact through their proxies (avatars) query applications (Web agents) soliciting them to collect, filter, verify, correlate and present answers to their queries often in a more visually palatable three-dimensional format. Following a brief overview of these two technologies, this article presents several of the key force drivers behind their evolution and the benefits gleaned from their collective use. Further discussion identifies new methods for visualizing semantic content in virtual worlds. Finally, as with any technological evolution, the merge of these two technologies brings on a whole new set of challenges from a Web user's perspective as well as perspectives from technology developers both in academia and government.

Keywords: Virtual Worlds, Semantic Web, Government, 3-D Web.

Compounding the Results: The Integration of Virtual Worlds With the Semantic Web

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Evolution of Two Technologies

The exponential growth of the World Wide Web (WWW) over the past two decades has been witness to many technological innovations. The linking of Web-documents via early mark-up languages such as Hypertext Markup Language (HTML) and Extensible Markup Language (XML) has stimulated growth and knowledge sharing on a global scale in literally all aspects of government. As the Web has evolved so has our desire to become more involved with the process of content-sharing and content-creation. Now, new Web-based technologies look to provide smarter, more meaningful content and present such content with a new level of depth and interactivity. Welcome to the Semantic Web presented to you in 3-D. The following discussions give a brief overview of these two technologies: the Semantic Web developments, and 3-D Web Virtual World environments.

A More Meaningful "Semantic" Web

The evolution of the Web over the past two decades saw a 1990s era, often referred to as Web 1.0, that focused on read-only content and static HTML-based Web sites. Web 1.0 Web sites were generally not interactive and the protocols concentrated on linking documents on the Web (Strickland, 2009). Web use over the past decade, often referred to as Web 2.0, has been more about user-generated content. Web 2.0 has been more of a read-write Web where users have been contributing as well as consuming Web content through forums, blogs and social sites like Twitter, MySpace, YouTube, and Facebook [Strickland (2009) and O'Reilly (2005)]. Current growth estimates for the Web indicate that nearly 1 billion new Web pages are being added to the Web daily and that is on top of the estimated 48 billion Web pages that are currently presented on the nearly 75 million Web servers that make up today's World Wide Web (Aker, 2009). One of the key challenges for both governmental agencies and the general public in the coming decade will be to find more meaning out of this vast, ever-expanding amount of Web data.

At the crux of the issue here is that while computers understand the syntax of what to retrieve they do not understand the meaning or semantics behind the content they present to Web users. Today's search mechanisms find information on the Web largely through search words or phrases. The challenge with the majority of data on the Web is that in its current form it is difficult to use on a large scale. Every discipline and government agency or unit has its own lexicon and by using controlled vocabularies this limits the range of data retrieved due to too strict a syntax. Plus, similar words can also have different meanings (example: the word "whip" in congress has a different meaning to a "whip" used to herd cattle) and contrarily, different words can have similar meanings. The current solution to this is to create multiple word searches. Multiple words or phrases is a powerful feature in many of today's (largely non-semantic) search engines since additional words help to narrow the context (example: "whip in congress" or the other: "cattle whip"). There is also a growing concern involving the notion of a "collective intelligence" Murugesan (July-August, 2007), Mikroyannidis (2007) and Gruber

(February, 2008) that helps fuel the need for having everyone searching for similar concepts to be on the same “page(s)” regardless of where that data may reside (blogs, wikis, etc.). What differentiates the current Web with what Tim Berners-Lee saw as a logical next step 10 years ago, is the need to structure Web data in a way that both users and computer systems are able to take meaning from the same data (Berners-Lee, 1998). The Semantic Web technologies, a part of the Web 3.0 phenomenon, have been evolving over the past decade with a focus on the semantics or meaning of the data that is available on the Web. The premise here is that more meaning to the Web content will bring about more intelligent searches and a more personalized experience for Web users (Agarwal, 2009). Building a Semantic Web is akin to creating a collectively intelligent and globally linked database from the Web in such a way as to be easily processed by the computer systems that maintain it with the overarching goal of providing a more efficient means of retrieving the data on the Web. Efficiency is particularly of importance in areas of local government where immediate decision-making and action result in life-saving efforts. By simply having a better-designed Web search, retrieval and dissemination options will enable a better government interaction from remote areas to execute necessary field operations (VanLeuven, March 2009).

Key Semantic Technologies

As the technologies surrounding the implementation of the Web evolve so does our notion and thus our expectation of what the Semantic Web is to be. One concept is clear though, by embedding additional semantic metadata into Web data via technologies such as the Web Ontology Language (OWL) schemas and common vocabularies like the Dublin Core and Friend of a Friend (FOAF), Web developers will be able to engage new tools to extract more “meaning” from their various searches and interrogations of the Web (Smith, Welty, & McGuinness, 2004). By incorporating data modeling like Microformats and Resource Description Framework – in-Attributes (RDFa) used to describe Web resources - computer systems will gain the “meaning” in the Web content to better serve its Web users (Ding,, et al., 2004).

In another recent Semantic Web milestone,, the W3C published a new query technology called SPARQL (pronounced *sparkle*). SPARQL is a key standard for opening up data on the Semantic Web. SPARQL defines a query language and protocol that interacts with the other core Semantic Web technologies such as RDFa for representing data, OWL for building vocabularies, and Gleaning Resource Descriptions from Dialects of Languages (GRDDL) used for extracting Semantic Web data from documents (W3C, W3C Opens Data on the Web with SPARQL, 2008). With the implementation of SPARQL, Web-based applications are now able to query information from databases and other diverse sources in the wild, across the Web (Berners-Lee, 1998).

Virtual Worlds Providing (3-D) Web Experiences

Simulating real-life objects and environments had some of its precursors in government-driven research. Developments in military exercises for troop battlefield operation simulations proved safe and cost-effective as compared to other training modes (Huifang, Deng, Guo, & Chen, 2009) and (Murphy, 2008). Over the past decade this technology initially translated into the public mainly in the gaming industry, then into academic research and now into the general public for all to access via the Web. Alongside other recent Web developments, 3-D Web technologies have evolved to a point where Web users are beginning to experience some of the benefits gleaned from 3-D verses 2-D presentations.

In recent years, the use of 3-D Web environments has seen a tremendous growth to a point where the Web now supports nearly 580 million people worldwide that are registered in virtual worlds today with nearly half of those falling into the up and coming 10-15 year old age group (K. Zero, 2009). Current reports also show nearly 150 virtual worlds in existence today with that number are expected to grow to 900 or more within the next three years (Mitham, 2009). Given survey statistics, building a profile of the typical government Web user may be somewhat illusive. The government does, however, recognize the need to target different age groups for specific content presentations like the Bensguide.gpo.gov site aimed at children. Further study also seems to suggest correlations between age leaning towards e-research (searching for a subject or topic - resource library) when younger and e-governance (searching for political or policy-related area or service - legislation or online voting info, how to pay taxes) when older (Thomas & Streib, 2005).

As a 3-D Web interface, virtual worlds provide users with unique capabilities. However, when discussing the values of a 3-D interface it is important to understand the basic design elements and principles that exist as a part of our human condition and how they affect the implementation of a Web interface. To more clearly understand what functionalities encompass a virtual world experience Virtual Worlds Review (2009) cites six features that all virtual worlds have in common:

- **Shared Space**: the world allows multiple users to participate at once.
- **Graphical User Interface**: the world depicts space visually.
- **Immediacy**: interaction takes place in real time.
- **Interactivity**: the world allows users to alter, develop, build, or submit customized content.
- **Persistence**: the world's existence continues regardless of whether individual users are logged in.
- **Socialization/Community**: the world allows and encourages the formation of inworld social groups (What is a Virtual World?, 2009).

As Burden (2009) points out, “virtual worlds are NOT about what they look like, but about what’s in them” and what is growing is a continous demand for access and interactions with Web content in the form of information and resources that manage and retain that information. From a functionality perspective, early virtual world developments have taken advantage of Web 3-D technologies in many areas including social presence, persistence, and the visual presentation of the environment. However, the early emphasis has been on building out these worlds and providing for a growing demand for more social-context and interaction, there are some recent indicators that show a growing interest in the use of virtual worlds as vehicles for presenting content.

Despite the inventiveness and creative push in virtual worlds for military training and intervention, these areas lagged in all other areas of government. Continued interest and calls for better collaborative technologies rose from scientific researchers, business and social networks (Masinsin, May 2008). “Government agencies are just starting to recognize the merits of Web 2.0 technologies.” (VanLeuven, March 2009). For educators, researchers, business and community networks the push for combined technologies was steady.

Key Forces Driving These Two Innovations

Incorporating a Web with more meaningful content within the VW environments we are now developing, it brings together not only the benefits of a visual 3-D experience and its sense of social presence but it also provides Web users with an added depth of perception that adds new space to the presentation of increased volumes of more meaningful content through the implementation of semantic technologies. Where the Web 2.0 focused on social interaction and user-generated content with the Web 3.0, the focus shifts to support the coming volumes of computer-generated content. Sweeney (2009) describes the significance of this shift as being akin to a modern industrial revolution only this revolution takes content-generation to an entirely new level. Several current examples of computer systems that are automating the tasks of locating, selecting, describing, organizing and assembling content under the direction of Web users include:

- **Google News:** a computer-generated news site where the articles are selected and ranked by computers.
- **Kosmix:** a categorization engine that organizes Web content into magazine-style topic pages.
- **Wolfram Alpha:** a knowledge computation engine that dynamically calculates facts in response to questions.
- **Primal Fusion:** a thought-networking site created through a semantic synthesis technology.
- **BING:** a semantic-based decision engine with access to indexed Wikipedia content.

Users Can Do More and Want More

It is not only technology that is progressing. The way the Web is being used and how information is searched have also become more advanced. Here we are discussing two categories of key forces. One is another technical force factor that is focused on the "how" and not the "what" as in technical tools. The other key force is the "human/user-factor." Web 2.0 is more than the tools we use, but how we are using them. Quite often, social, academic and professional networks collide. This second force is the human factor. Human factors of consumption and contribution are driving the technology beyond the current advantages of Web 2.0. This is not very different from a business model with regard to its consumers. Frankly, the technological combination is market-driven. Users are consumers driving this upcoming and developing market. Consumers want all the advantages of Web 2.0 and more. Several of the advantages of Web 2.0 include user-centered and user-driven, both synchronous and asynchronous and tech-friendly ability for readers to also be writers. Morevoer, information is easily updated as well as the interconnection of social and professional networks.

As Web technologies evolve independently, the possibilities expand exponentially when two or more technologies find significant synergy. This is especially the case for social and professional networks. We generally find each of them linking to or embedding each other. This "tech blur" is leading the charge for a layering of technologies which are either cross-compatible or interconnected. Other key forces currently driving these two technologies are found in usage statistics covering several realms of Web activity and are proving key to the emergence of both of these technologies.

Overall Global Internet Usage

According to InternetWorldStats.com, there was an increase of 132.5% in Internet use throughout North America between 2000 and 2009. The increase in use globally is more remarkable showing a growth of more than 340% for global internet users between 2000 and 2008 and these upward trends are expected to increase in the foreseeable future (North America Internet Usage Statistics, Population and Telecommunications Reports, 2009). Although government entities use a number of domain spaces such as ".mil," ".arpa," and ".gov" domains, space now includes over 27,000 government registered Web sites (iReport, 2009).

Growing Interest in Virtual World Usage

The arrival of several Web 3-D virtual environments used for academic, professional, and community networking confirms a strong public interest in and growing acceptance for this evolving Web medium. In 2007, research data show sharp increases for VW registrations and log-ins amongst some of the most popular environments (Virtual Worlds Platforms and User Numbers, 2007). There is also a growing number of virtual worlds that are considered "open source" and these world models are free, non-proprietary and available to the general public. The number of virtual worlds has been doubling about every 2 years. That puts it in synch with Moore's law and it is anticipated that the market for virtual goods and services along with the amount of money made by individuals interacting within these virtual environments will all continue to grow at a significant rate (Metaverse Roadmap Forecasts - Part A, 2009). On a daily basis Linden Labs alone with its virtual world currency, the Linden Dollar, was averaging $1.5 million in monetary exchange, (Richards, 2007). Furthermore, as these various virtual-environment-evolve-users are also looking at ways to gain gateways, such as those provided by Myrl's solution, between environments that allow them to share their virtual experiences (KZero.co.uk, 2008) and (Myrl.com, 2009).

Increased Complexity of User System Queries

There has been an exponential growth in Web-based query activity. In 1998, the average query length for a Web search engine was approximately 1.3 words. By 2005 that average query length had doubled with a volume of half a billion queries a day on Google alone. If this trend of doubling the query length every seven years continues, then extrapolation shows that 5.2 word query averages can be expected by 2012 and 10.4 word queries or queries the equivalent of a complete conversational-style sentence can be expected within the next ten years (Metaverse Roadmap Forecasts, Part A, 2009).

Another factor is the strength of more specialized searching for users. Most Web users are aware of the typical broad-based or "horizontal" searches provided by most well-known search engines, but there are also searches that focus on a specific information type that are collectively referred to as "vertical" searching. Vertical search tools include vertical engines like Answers.com, Indeed.com, Become.com (Regan, 2005), and Google Book Search is Google's vertical search engine that lets you find matching pages within books that it has scanned. Curious about that part in Tom Sawyer where he was whitewashing the fence? Then enter "tom sawyer fence" and Google Book Search tells you it is on page 22 of Mark Twain's classic novel (Sullivan, 2007).

Bridge to Social and Professional Networks

The strength of research is its ability to connect information wherever it happens to reside. It is not a coincidence that both social and professional network domains are becoming blurred. MySpace, Facebook, YouTube and Twitter are but a handful of examples of those being sought after for both social and professional means. Social and professional Web sources have crossed over and merged a symbiotic connection to each other. Now the research communities have had to cross a bridge too. No longer are the three areas of academic, social and professional, heavily divided such as in the past.

Now, research efforts must also include specific information taps on social and professional networking sites. The fact now remains, there is retrievable information and/or raw data present in social networking spaces like blogs, wikis and tubes with many cites and links to other "personal" or "professional" spaces of experts in specific fields. These field experts are conducting original research and making valuable information available in areas outside of more traditional means. This relatively new social phenomenon leads us to why researchers need different types of search options beyond the traditionally published scholarly book, journal or technical report.

Increased Use as a Telework and Educational Media

Due to the evolving Web-based technologies at real world worksites, employers are seeking employees who are able to perform duties remotely. Telecommuting or telework may not be done on a full-time basis, but much work is often completed off-site electronically whether the employee is officially on the clock or not. The number of Americans whose employer now allows them to work remotely at least one day per month has increased 39 percent the past two years, from 12.4 million in 2006 to 17.2 million in 2008 with those numbers expected to increase significantly in the coming years (Marica Rhodes, 2009).

Online education has also become a more viable alternative to campus-based learning for an increasing number of individuals who maintain employment, families and wish to further their education on their own time. Educators are finding new and innovative uses for 3-D Web-based environments. Virtual Worlds allow students to go places that cannot be visited, overcome stereotypes, role-play, collaborate in groups, conduct scenario simulations, and interact with a global audience. The increase of Distance Education (DE) enrollment and use of distance Web-based technologies in the classroom at many major institutions is met with a driving force to seek out and identify different synchronous and asynchronous instructional models to meet the demands of users who require 24/7 service. Distance education has become increasingly common in postsecondary education; national statistics indicate that in a single academic year of 2006-7, 66 percent of both 2- and 4-year colleges offered distance education courses and there is a growing use of Web-based tools in traditional face-to-face course offerings as well (Distance Education by Postsecondary Faculty, Indicator 47, 2006).

Government Initiatives

Federal, state and local government use of Internet space is increasing and so too is the public use of them. When discussing direct services by such agencies as the Social Services Administration O'Looney (2005) notes that given “the public goods nature of the Semantic Web, governments should assume some of the responsibility for being first movers in investing in the Semantic Web.” At the national level, the Defense Advanced Research Projects Agency (DARPA) has been investing millions of dollars in the core technologies of the Semantic Web. There is a growing need for large governmental units with multiple data stores to integrate this data and the semantic information infrastructure can provide the large-scale accessibility to those data stores (O'Looney, 2005).

Government agencies have an implied mandate to facilitate, expand and secure a means for the general public to search and find information and with the volume of data expanding at such rate it demands new and innovative approaches that semantic and 3-D Web technologies provide. Today's governmental Web infrastructures are among the largest and most diverse in existence and are ideal environments for expanded use of semantic technologies. Recently, several semantically-based governmental sites have begun to take advantage of these new technologies. The recovery.gov site is another example of a federal governmental site designed to present the vast amount of data involved with the on-going economic stimulus efforts.

A current federal effort focuses on increasing public “access to high value, machine readable datasets generated by the Executive Branch of the Federal Government.” At present, the Data.gov effort includes searchable data catalogs providing access to all forms of government data. A recent review of the Data.gov draft Concept of Operations document indicates the organizations movement towards semantically published data (Miller, 2009).

Visualizing Semantic Content in Virtual Worlds

Improving the Web user’s ability to visualize the vast new amounts of Web content will find VW technologies on the forefront of this new era of Web usage. In a recent Forrester Report on the use of virtual worlds in the work sector, Information Technology (IT) professionals were urged to begin investigating the uses of virtual worlds. While experimenting with virtual world technologies, they had to attempt to “replicate the experiences of working physically alongside others; allow people to work with and share digital 3-D models of physical or theoretical objects; and make remote training and counseling more realistic by incorporating nonverbal communication into same-time, different-place interactions" (Driver & Jackson, 2008).

However, Burden (2009) notes that most initial assessments of VW environments have focused on the looks and not necessarily on the functionality of the environment. Therefore, to maximize the usefulness of these two technologies, new and more effective virtual environments will need to be first visualized and then designed to present these workers, students, researchers and other Web-content users with working environments that have the ability to present the results of their semantic queries in a three-dimensional virtual space. All this while should be accomplished by also providing an interactive environment which enables users to alter, develop, build, or submit their customized queries in real time.

Whether in two or three dimensions, computer-based displays are designed to support the perception of relevant system data and to facilitate further processing of that data. In their work on human factors engineering, Wickens, et.al. (2004) outlined 13 principles used to create an effective display design. When visualizing new virtual world spaces that support semantic content, several of these principles come into play.

Principle 6 - Pictorial Realism.

This principle implies that a display looks like the variable that it represents. As an example, if attempting to display a high-temperature value on a thermometer then the display should be shown as a higher vertical level. If there are multiple elements, they should be configured in a manner that appears like it would in the represented environment. The key here is that however the content is presented, it should have a visual appearance that is real to the user. According to Scott (2009), the semantic Web is "about real-world objects. It is about things that people care about, things that people think about," (Scott, 2009).

Principle 7 - Moving Part.

Again, the concept of real-world presentation surfaces in principle. The principle of the moving part implies that moving elements should move in a pattern and direction compatible with the user's mental model of how it actually moves in real world. An example would be the moving element on an altimeter; it should move upward with increasing altitude and down with decreasing altitude.

Principle 8 - Minimizing Information Access Cost.

This principle implies that when the user's attention is averted from one location to another in order to access the necessary information, there is an associated cost in time or effort. A display design should minimize this cost by allowing frequently-accessed sources to be located at the nearest possible position. However, adequate legibility should not be sacrificed to reduce this cost.

Principle 9 - Proximity Compatibility.

This principle infers that divided attention between two information sources may be necessary for the completion of one task. These sources must be mentally integrated and are defined to have close mental proximity. Information access costs should be low, which can be achieved in many ways like close proximity, linkage by common colors, patterns and shapes. However, close display proximity can be harmful by causing too much clutter.

Principle 10 - Multiple Resources.

This principle implies that a user can more easily process information across different resources. As an example, visual and auditory information can be presented simultaneously rather than presenting all visual or all auditory information.

Principle 11. Replace Memory With Visual Information - Knowledge in the World.

This principle means that a user should not need to retain important information solely in working memory or to retrieve it from long-term memory. A menu, checklist, or another display can aid the user by easing the use of their memory. However, the use of memory may sometimes benefit the user rather than the need for reference to some type of knowledge in the world like an expert computer operator would rather use direct commands from their memory rather than referring to a manual. The use of knowledge in a user's head and knowledge in the world must be balanced for an effective design, (Wickens, Lee, Liu, & Gordon-Becker, 2004).

The basic function of any computer interface is to enable the user to communicate with the computer as transparently as possible. Rosenthal (2001) suggested five areas for consideration when developing 3-D Web interfaces:

1. **3-D World Simulation Brings With it two Elements**: Both Navigation and Emotional involvement. Immersion within the real-world RL will, by the nature of our being, cause an emotional response. "Being there" within the virtual world will affect our thoughts and feelings in a different way than the detached 'windowed" 2-D interface can offer.
2. **An Object's Consistency in the World**: Inanimate objects around us do not move around and navigate as we do. The challenge of the 3-D interface is to make the change known so that whatever purpose is served by the objects transformation, its "history" must be known by the user so that the object is useful for them.
3. **Audio to Suggest Spatial Relationships**: The ability to localize audio and effect is the volume within the 3-D world. It allows the audio interface to become as important as any visual cue to understanding the world we are within.
4. **The User's Effectiveness to Alter the Environment**: We affect and alter our real environment constantly. The user's ability to create "cause and effect" will immediately place them in the world and define its rules. When a rule about an object is broken, consistency is lost and the user cannot be sure of an action's reaction.
5. **Time, Scale, and Distance as an Interface device**: The manipulation of time and its relation to 3-D space can become a navigational nightmare within the 3-D interface. Our body size in the real world sets many of our notions of time, scale, and distance. It is no coincidence that we measure distance in "feet." We use our own mass and size to "fit" into our real world. Within a flat screen on our desktops, 3-D offers the world paradigm but to most at small scale - a screen that is about 15-20 inches across, (Rosenthal, 2001).

This addition of the third dimension to Web content presentation brings with it a level of depth to the 2-D screen experience. It is this 3-D illusion and sense of presence which enables the Web user to be now be inside the environment or inworld (IW) as opposed to just viewing it from the surface. That is the greatest of challenges for Web interface designer and developers. To maximize the value of virtual world technologies and to provide for a more effective presentation medium for the Semantic Web, consideration must be made to each of these five areas listed above. Given the five dimensions, it is a logical step that researchers are going from finding objects semantically from mostly static pages to searching for them in a virtual world. The roads on the super-information highway are taking new form (Liefman, Meir, & Tal, September 2005).

I. A Focus for the Near-term: Viewing the Road Ahead

Having strong semantic search engines will likely improve search options and increase the researchers ability to retrieve relevant data otherwise missed by more traditional search tools that have relied mostly on controlled vocabularies. The Semantic Web seeks out the unique syntax and concepts shared within a specific field of study and enables database results to incorporate a “concept-driven” instead of “pure word” locating process. Thus, 3-D Web environments provide a way to bridge people and technical tool sheds, placing both inanimate and animate objects as well as pure data into a functional co-existence.

Moreover, the benefit of coupling the two technologies is achieved by creating a community of scholarly experts, regardless of distance, teamed in real-time, searching, retrieving, manipulating data in any given discipline.

Finally, there will be a way for everybody to access empirical research data we can see (graphic representation), define (semantic) and touch (activated avatars). Nevertheless, careful considerations must be given with regard to determining points of emphasis. It is of paramount concern for a successful journey using Web 3.0 technical tools in combination with semantic search mechanisms to not rely so heavily in graphic-quality where contextual quality is weak.

Going Beyond the Visuals

In 3-D environments, there is much emphasis on realism – graphic quality. With the advent of semantic searching the virtual environment can become a place evaluated on its sight, sound and meaning. If the tech combo is to be a success in all three realms (social, academic and business) then laying the groundwork for semantic mark-up of content (largely presented as objects instead of text) within virtual worlds would be a first-priority concern. The value of virtual worlds will increase if inworld contents are not only visually appealing, easily manipulated and realistic, but they must also be searchable and retrievable (Burden, Toward Semantic Virtual Worlds - A Thinkpiece, 2009). Research supports that content is key for government sites. Thomas and Streib (2005) noted that despite “the Internet image as a channel for commerce, the public mostly views it as a source of information, and these uses appear to explain its popularity much more than its utility as a way to shop, bank, or invest” (Thomas & Streib, 2005).

A Trend Towards Mashups

Throughout the work there is a constant reference made to two combined technologies. Yet, it is arguable that there is actually a combination beyond just the two isolated technologies for detailed discussion here – that it is, in fact, several types (Web 1.0, 2.0, Web 3.0/Semantic and VW/3-D). What happens when we get all these technologies working simultaneously? We get an effect that is often referred to as mashup. Originally used to describe the mixing of music tracks to yield something different and new, mashup is an “unusual or innovative composition of content (often from unrelated data sources), made for human (rather than computerized) consumption” (Merrill, 2009).

The term mashup typically implies quick, easy integration, frequently using open APIs and data sources to produce results that were not the original reason for producing the raw source data. Between the visuals, information seeking, retrieving and manipulation mashups, we find that virtual worlds such as Second Life evolve into not merely a mock of reality, but a totally different, separate and self-sustaining one. An anthropological perspective offers the notion of virtual worlds as a merge of craft and knowledge – a "crafty knowledge" (Thompson, 2009).

Becoming Immersed in Data

The governmental data environment is unique and its challenges to synthesize and present that data to the public are enormous. Achieving any level of interoperability on a global scale is a monumental endeavor; all this while handling the countless semantic differences of interpretation across many fields of service (legal, administrative, and civil services) with differing processes and best-practices, and coupled with the numerous languages and dialects across counties, states and in national and international levels. Examples of the two technologies can be found in several disciplines. According to Daden Limited, "Several virtual worlds support the ability to bring data in from the Web and the real world - either as batch files or live data from Web services feeds" (Daden Limited, 2009).

Governmental agencies with disciplines in areas such as astrophysics, bioinformatics, geography, geophysics, biology (and the list goes on) are all starving for new communication venues. These two technologies provide a much needed interactive media to facilitate communications across the science, technology and engineering communities. Djorgovski, et al. (2009) note that many of the world's great challenges including global climate change, and energy conservation are "fundamentally interdisciplinary in nature, and not reducible to any given scientific discipline (physics, biology, etc.), the lack of effective and pervasive mechanisms for establishment of cross-disciplinary interactions is a serious problem which affects us all" (Djorgovski,, et al., 2009).

Emphasizing the Need

We can trace the practice of archiving and retrieving information back to around 3,000 BC when the Sumerians, realizing the importance of proper organization and access to archives, began designating special areas to store clay tablets with cuneiform inscriptions (Staikos, 2009).

The coupling of data retrieval and manipulation in real-time amongst Web users is fast becoming a desired process and these two technologies should prove their worth in the coming decades. However, as these two technologies begin to merge, they will both bring their own sets of challenges but from a Web user's perspective and a technology developer's perspective. Yet, vast quantities of governmental public sector data are available on both public and governmentally secure infrastructures.

Data ranges in scope from statistical and financial, geospatial and imagery, as well as legal, operational and administrative information. Making this data both available and reusable are two very unique challenges. Most governmental data are published in numerous formats with little structure that inhibit their reusability. This continued use of unstructured, non-semantic representations of data makes it nearly impossible for computer systems to collect, with any level of understanding, and present the data in meaningful formats for both governmental employees and the general public. But it is not just the challenge of making the data more meaningful, we must also embrace a new era of data presentation, an era where 3-D Web-based virtual world environments provide users with a new sense of "Data-in-Depth."

Moving forward, how governments publish their data and ensure its readability are going to be critical decisions. The publishing of semantically-structured data that is read through Web

3-D virtual world technologies will form a major solution to adding increased data transparency while absorbing the growing volumes of Web-based government data in the future.

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