Of Hoverboards and Hypertext

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Abstract. In 1968, Doug Englebart and his team at the Stanford Research Institute amazed the world with their oN-Line System (NLS), giving what has since been dubbed the "Mother of all Demos." The NLS system, later renamed Augment, was the first Graphical User Interface, the first Word Processor, the first Wiki, the first Hypertext system, essentially the first of many applications we think of as modern. Much of the progress in software of the last forty-five years can be seen as attempting to realize the vision first articulated by Englebart at the '68 Fall Joint Computer Conference.

However, it has only been recently, with the advent of HTML5 and related standards, that the entirety of the NLS/Augment system can be implemented in the browser in a standardized fashion. This article examines what has changed to finally allow the realization of a half-century old vision and investigates why it took so long.

We ask: where are we going next? More importantly, where *should* we be going?

1 Introduction

In the 1989 film "Back to the Future Part II," the protagonists Marty McFly and Doc Brown travel to the year 2015 and have a glimpse of the future. That future includes holographic movies, self-tying shoes and, most importantly, hoverboards. [1]

With 2015 only two years away, the hoverboards that seemed entirely plausible in the 1989 film are incredibly unlikely. In fact, it seems neither that hoverboards are going to arrive in the foreseeable future, nor that they would be especially useful if they did arrive. Despite this, in 2010, an artist created a hoverboard replica (that really floats) for installation in a museum.[1]

Hypertext finds itself in a similar, if somewhat more prolonged, situation. Early visionaries foresaw the future of computing over fifty years ago, and created its precursors not long after. Those early pioneer's visions still haven't been realized in their entirety, but the pieces that have are responsible for most of the innovations of personal computing. Hypertext researchers over the years have built on top of those early visions, but with few exceptions they see little use outside of labs, not much more useful than a hoverboard in a museum.

This paper argues that the problems faced by hypertext pioneers have indeed been realized, although not through scientific deliberation and standardization, but through

[1] http://vimeo.com/11968215

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a hodgepodge of academics, industry and government. Furthermore, if the hypertext community does not embrace the tumbling torrent of disparate actors and conflicting goals that define modern technology, we risk irrelevancy, as industry will surely step in to fill in the gap.

The essential concepts of hypertext are almost as old as text itself. The Talmud, Bible Concordances and the I Ching hold the fundamental characteristics of intertextuality and reader interaction that inform modern hypertext theory [2].

In papers such as this, it is customary to cite Vannevar Bush's "As We May Think" published in *The Atlantic Monthly 1945* [3] as the birth of modern hypertext, although he was preceded technically by Emmanuel Goldberg [4–6] and theoretically by Paul Otlet [7, 8]. However, in a premonition of what was to come, it was Bush's evocative, accessible description of his imaginary Memex machine, as opposed to the more technical and obscure writings of his forerunners, that inspired a generation of Computer Scientists who would go on to create the world's first computerized hypertext systems.

It was almost twenty years after Bush's article, in the early sixties, that his spark would finally flare into the systems that would become the first computerized hypertext. The first half of the decade saw the publishing of Doug Englebart's Conceptual Model for Augmenting Human Intellect [9], and Theodore Nelson's coining of the word 'hypertext.' [10, p. 13].

Later in the sixties, the Nelson inspired Hypertext Editing System (HES) [11] pioneered a new approach to documentation that would be used by the Apollo program [12], but it was Doug Englebart's oN-Line System (NLS) that would explode hypertext (among other ideas) into the wider academic consciousness. [13, p 144]

Following those projects were a parade of innovative systems straight through the late eighties, most notably: HES's successors - FRESS and DPS [12], The Aspen Movie Map, KMS, Hyperties, Symbolics Document Examiner, Intermedia, and the first runaway commercial hypermedia success, HyperCard [14]. But none of these are as grandiose and tragic as Xanadu. Xanadu is emblematic of hypertext systems in general: exceedingly clever, seemingly crucial systems that never see any widespread uptake. [15, 16]

For better or for worse it was Tim Berners-Lee's WorldWideWeb, as implemented by the NSCA's Mosiac web browser, that would finally set the world ablaze from the carefully laid kindling of the hypertext community.

The web, as it's come to be known today, has brought the world together in previously unimaginable ways, but members of the hypertext community lament its superficiality and lack of attention to the work that came before it, calling it variously 'Hypertext 0.5,' [17] 'prodigal' [18] and 'feral.' [19]

To determine what's missing from the web and why those elements are important to the community, we must first look back to the stated goals of one of the early pioneers of hypertext: Douglas Englebart.

2 NLS/Augment

Douglas Englebart's goal was "increasing the capability of a man to approach a complex problem situation, to gain comprehension to suit his particular needs, and to derive solutions to problems." [9]

Englebart's thought was to build a system which information workers, such as himself and his team at the Stanford Research Institute might use to become more efficient. As such, they were the primary users of the system they built, in a process Englebart called 'Bootstrapping.' [20].

When Englebart demonstrated the resulting system at the Fall Joint Computer Conference in 1968, he showed the audience the first word processor, the first wiki, the first graphical user interface and the first computerized hypertext, all within his oN-Line System. Englebart had given a glimpse of the hoverboard hypertext of the future, and the computing world would never be the same. [13]

Unfortunately, although the ideas presented defined personal computing for decades to come, that conference was a high point for the NLS system. As more people used the system, its complexity began to show. Englebart believed that a certain level of complexity was acceptable, reasoning that if people were willing to spend three years learning how to speak a language and ten years learning mathematics, they could afford to spend a few months learning to use a computer. [p. 245] [13] However, even with other computer experts, its complexity and rigid hierarchy did not sit well. Englebart's colleague, John MacCarthy, head of SRI's AI program, tried to write a paper using NLS and found it so difficult that he swore he'd never use it again [13, p 171].

Despite the excitement generated by the demo, work on NLS declined throughout the early seventies. Much of Englebart's team jumped ship to Xerox's new research institute, PARC. At PARC, Englebart's ideas found expression in the world's first personal computer, the Alto, but only at the cost of cutting out all of NLS's complexity and hierarchy.

Just as Goldberg and Otley's ideas didn't catch on until Vannevar Bush expressed them clearly in *The Atlantic Monthly*, Englebarts ideas only found expression after being refined and adapted for a wider audience than simply highly trained experts. [21]

3 WorldWideWeb

The World Wide Web is at once hypertext's killer app and its greatest disappointment. It has spun hypertext across the world, but done so at the cost of ignoring most of classical hypertext's richness, at least on the surface.

The original goal of Tim Berners-Lee's WorldWideWeb was to store information and documentation relating to research groups at CERN. But Berners-Lee recognized that the problem he was solving was more general. "Suppose all the information stored on computers everywhere were linked," he thought. "Suppose I could program my computer to create a space in which anything could be linked to anything." [22, p 4]

The WorldWideWeb was not the only hypertext system available, nor was it even the only internet based hypertext system. But it became the most successful. Exactly how and why this happened is a topic of debate and discussion, [23] but that it has happened is undeniable.

Berners-Lee and his associates had built a solid foundation, but it was the NSCA's Mosiac web browser that gave the web mass market appeal. Mosaic went from nothing to an estimated 93% browser share in one year, [24] in large part because its creator, Marc Andreessen, focused intently on what users wanted [25]. Following Mosaic's

success, both Microsoft and Netscape (among others) released competing browsers, setting off the first "Browser Wars" in 1995 [26].

HTML, driven by industrial competition, was improved rapidly, moving from HTML 2.0 in 1995 to HTML 4 by 1997, before settling on HTML 4.01 in 1999. [27] Many of the essential tenets of the modern web were developed during that period: JavaScript (developed by Netscape) [28], CSS (developed by the W3C) [29], Asynchronous HTTP (developed by Microsoft) [30], and XML (developed by the W3C) [31], all made their debut during this time.

Microsoft's practice of bundling Internet Explorer with Windows won the first browser war, but it wasn't long before Mozilla [32] was joined by Apple and Google in creating powerful open source browsers, sparking the second browser war.

During the lull between the browser wars, the W3C worked on web related specifications, not demanded by the browser manufacturers, including XML and Semantic Web related technologies, such as RDF and OWL. Breaking with its tradition of standardizing already existing HTML implementations, or highly requested features, the W3C set about defining XHTML 2.0, a non-backwards compatible update to HTML 4/XHTML 1.0. This would prove to be a colossal mistake for the W3C.

Browser vendors completely ignored XHTML 2.0, and created their own group for the advancement of Web Standards, the Web Hypertext Application Technology Working Group (WHATWG). This group defined the HTML 5 standard, later dropping the number to have a so-called "Living Standard." Although the W3C has dropped their work on XHTML 2.0 and standardized HTML 5 instead, since the membership of WHATWG is made entirely of the major browser vendors (with the exception of Microsoft), that group is essentially the authority on web standards today, leaving the W3C completely behind. [33]

WHATWG's living HTML standard is more than just the markup language used for webpages. It has grown to include the Document Object Model, Cascading Style sheets and JavaScript, as well as various JavaScript APIs such as geolocation, offline storage and more. [34] With the fast pace driven by Microsoft, Google, Apple and Mozilla's battle for supremacy, new concepts and ideas are being constantly added and improved to the HTML5 collection of standards.

4 HTML5 Augment

The web has evolved far beyond Tim Berners-Lee's original vision. Indeed, right from the start, few web browsers outside of his own supported inline editing of webpages. Today, none do. Even his WorldWideWeb browser was less 'hypertext-y' than his original ENQUIRE browser, which had bi-directional, annotated links. [22] However, it is a testament to his design and leadership that the web has been able to evolve to what it has become today.

With the new power of HTML5 related standards, the web has become a platform in its own right. Google[2], Microsoft[3] and Zoho[4] all offer complete office software,

[2] `http://docs.google.com`
[3] `http://office.microsoft.com`
[4] `http://www.zoho.com/`

entirely in the browser. There are sophisticated games[5] which can be played entirely using HTML. Indeed, Mozilla plans to release a smartphone with nothing *but* HTML 5 and related technologies later this year. [35]

All of these things have been possible for many years, with system dependent machine code, Java or Flash. But, for the first time there is a completely open, hypertext based, standardized platform that has the power to build essentially any application. In fact, HTML5 and related technologies has the expressive power to re-create Douglas Englebart's Augment system in the browser.

Attached to this paper is a demonstration of some parts of Englebart's original Augment system as implemented in HTML 5[6]. The system allows for the creation of a hierarchy of items, the association of locations with those items, and the plotting of these locations on a map. This demo makes use of the Canvas element for drawing the map and the local storage API for storing the items between sessions. These are both new to HTML 5, and such a system could not be made using standards compliant code wholly in the browser until now. Indeed, much of the technologies necessary for a browser based NLS system (e.g. JavaScript and Asynchronous HTTP) were not created by academics, or even the W3C, but by commercial browser vendors.

But we needn't stop here! HTML5 and related technologies are powerful enough to re-create any classical hypertext system, from Intermedia to Xanadu. Indeed, many of today's web apps have direct analogues with hypertext systems from the seventies and eighties, such as Google Maps (Aspen Movie Map) and Wikis (Knowledge Management System). [14]

So, although the web is 'wild' and 'untamed', out of the chaos we can create the orderly systems of yesteryear. The question is, should we?

5 Grappling with the Future

One of the defining features of the web is that it imposes few constraints on its use, either technical or political. Users are able to organize what they want, link what they want and write what they want, subject to the laws of their resident country. This was by design, as Berners-Lee saw the repeated failure of documentation systems at CERN as they tried to impose organizational hierarchies onto researchers. [22, p 14]

The web is designed like a market economy: anyone can do anything, but there are a few conventions and procedures they must agree to, such as currency and rules for fair trading. [22, p 36]. This wide open space created an ecosystem in which anyone with an idea could try it out, and potentially create something great. Most of the innovations associated with the web did not come from Berners-Lee or even the W3C: they came from companies or individuals who had an idea.

On top of the web's wide open ecosystem, a powerful platform has emerged. The web is not like any platform that came before it. There is no one group in charge, it's completely open, it runs almost anywhere and is somewhat standardized. But compared to the hypertext systems envisioned and created by early hypertext pioneers, this is no

[5] See, for example, this 3D game rendered entirely using CSS transforms: `http://keithclark.co.uk/labs/css3-fps/`

[6] See `http://web.cs.dal.ca/~yule/nls2/`

closer to the hypertext hoverboard of the future than a skateboard with a fan taped on. If the explosion of the web was possible with "Hypertext 0.5," imagine what we might do with a full blown hypertext system!

But of course, the web *is* a full hypertext system. If we can implement full hypertext systems using the web, its power must be sufficient for anything under the sun. And the simple fact is, the world is not the same as it was when classical hypertext systems were proposed.

Douglas Englebart's stated goal with Augment was quite simply to augment human abilities to allow us to cope with the growing complexity of problems in the world [36]. The web has put the world no more than a URL away. Project Gutenburg and its commercial cousin Google Books have made a significant portion human literary output instantly available. Wikipedia and digital libraries have made factual knowledge accessible on an unprecedented scale. An emerging class of low cost electronics[7] is putting that information in the hands of billions of people. Human ability has been augmented: mission accomplished?

But, just as Englebart foresaw, in creating these tools, we have created additional complexity. In making information easier to process, we've raised the expectation in terms of how much information we're expected to handle[8].

Tools that were created to solve problems at the dawn of personal computing are no longer relevant. The problems have evolved, and so have the expectations of those who use them. The first generation of so-called 'Digital Natives' are entering adulthood. These people have grown up with the web, and it completely informs their ideas of how to interact with information. For them, instant access is the norm. Although the web has become an incredibly sophisticated system, for them, it just works [38].

Unfortunately for its moving forward, the history of hypertext has been one of complete disregard for usability. Englebart specifically believed that his system would be complicated to use, but that end users would learn it eventually [13]. Xanadu's excessive focus on clever technology in the back-end meant its creators never had an idea of how someone might actually use the system [15, 39]. A major stumbling block for the Web, until Mosaic came along, was the difficulty of installing and operating a browser [22]. Certainly designing systems that will serve the needs of information experts is necessary, but it is hardly sufficient.

This is not to say we should be only aiming for a replication of the web. As academics, it's our job to create esoteric and quixotic systems that push the boundaries of what's possible. But there are big problems out there to solve, which are just begging for the application of hypertext.

Academic publishing is a topic that has been touched on by every generation of hypertext scholars. Bush's article, Englebart's NLS and Berners-Lee's WorldWide Web were all aimed squarely at changing the way academics process and share information and yet after 68 years, the only difference in how we submit a paper to a conference is

[7] For example, the Aakash 2 Tablet recently launched in India is roughly 1/30 the price of an iPad [37].

[8] See `http://informationoverloadresources.com/` for a list of resources on the rush of information, and how it affects us.

that we upload what is essentially an electronic duplicate of a printed page, containing no links, no annotation, and no multi-media beyond charts and graphs.

The hypertext community should be on the vanguard of new publishing technologies. Simply attaching a more hypertext-y version of a conference paper isn't good enough. The web has shown that we need to create a platform that is open, accessible and easy to use. It's embarrassing that in this day and age, the most sophisticated links possible between two papers is a citation at the end of a paper and the only annotations are footnotes[9]. The hypertext community should not wait around until a commercial vendor figures out how to take its ideas and exploit them.

Furthermore, although the web is the most obvious example of a widely used hypertext, story driven video games (Mass Effect, The Elder Scrolls, Final Fantasy, etc) have clear connections to ergodic literature, and thusly hypertext. In such a narrative based game, the choices the character makes affect not only the narrative but the entire world they live in. In the Mass Effect Trilogy, for example, narrative (not gameplay) choices made in the second game have consequences for the entire storyline of the third game, including which characters are still alive. Entire fields of study have sprung up to study various aspects of video gaming, from the sociological to the narrative, but the discussion of game as hypertext has been conspicuously absent, outside of their connection through Cybertext [40].

The hypertext community has built some incredibly [41] clever [42] systems [43] using a combination of web strategies and classical hypertext ideas. But these systems have yet to see widespread adoption.

5.1 Semantic Web

6 Conclusion

We are faced with a world suffocating with complexity and drowning in urgency. The tools inherited from the minds of the early hypertext pioneers have allowed us to meet the challenges of the modern world, but in doing so, created new ones. We need new tools and new approaches to confront the jungle of information we descend further into each day. We may dream of hoverboards, but until we can find a path through the information jungle, we're better off on foot. Furthermore, if we academics can't find our way out, we can be sure the business community will hack their way through with the machete of consumer satisfaction.

It took four decades, but we've finally managed to build a system on open standards that is roughly equivalent to the visions of the founders. We need new goals and a new vision going forward. Ideas such as adaptive hypertext [44] and the semantic web are clearly designed to solve a new set of problems. Indeed many of the ideas of adaptive hypertext have found expression in the behavioral advertising used by Google and Facebook, but surveillance by commercial entities is hardly the end goal of hypertext.

The web was built through dialogue and communication between academia and industry. The W3C had its greatest success leading from behind, allowing academia and industry to innovate, but ensuring all the players were speaking the same language. In this

[9] Like this one.

we can find a model for going forward. By no means should the hypertext community become fixated on creating products for the public. But that's not to say we shouldn't be aware of who might be interested in our ideas, and how they might expect to use them.

We propose new area of hypertext research, in addition to the three already in existence. Alongside theoreticians, designers and authors [45], we suggest a new category of researcher, implementers, whose responsibility is to think about how to bring the next generation of hypertext to the masses. This isn't about building a marketable product, it's about creating an ecosystem.

Many of the classical hypertext systems, from NLS to Xanadu to Microcosm [46] were an attempt to cultivate an orderly garden of information. But at this point, the only way to cultivate such a garden would be to clear-cut the Information Jungle, which is probably as poor an idea as clear-cutting real jungle. All we can do is create pathways through the jungle, and hope that we'll build tools such that where we're going, we won't need roads.

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