Contextual Narrative as an Information Architecture for the WorldWide Telescope

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Key Words

Digital Universes
Contextual Narrative
Interactive Learning

Summary

The evolution of the world wide web has enabled access to information about almost any topic conceivable. However, access to information is only one component of learning and understanding. How do people initially engage with unfamiliar or uninteresting subjects, where they do not know enough even to ask a question? How do educators and communicators make a topic sufficiently compelling to pique curiosity and sustain enough interest to facilitate learning?

This paper describes the underlying information architecture behind the WorldWide Telescope, called Contextual Narrative, as a model for interactive learning. Contextual Narrative seeks to integrate stories, contextual exploration and source information into a single environment to smooth the learning process, whether directed or self-directed. The WorldWide Telescope was designed to evaluate how Contextual Narrative can support exploration and understanding of a domain topic, in this case astronomy, by creating a compelling environment that facilitates the creation of linked stories in a multi-dimensional exploratory spatial environment with links to the rich information sources on the web.

Figure 1. Screenshot of a multi-wavelength composite image of Messier 81. Credit: WWT.

What Is the WorldWide Telescope?

The WorldWide Telescope (WWT) is a web application analogous to Virtual Earth that allows seamless browsing, zooming and panning of a spatial environment — in this case the sky — across multiple wavelengths. In addition to several all-sky surveys such as the Digitized Sky Survey, NASA's *Wilkinson Microwave Anisotropy Probe*, X-ray surveys and others, WWT includes many high resolution images from *Hubble*, *Chandra*, *Spitzer* and other space- and ground-based telescopes.

The many terabytes of images and data are distributed on remote servers in different locations on the web and stream down to WWT on demand as the user browses.

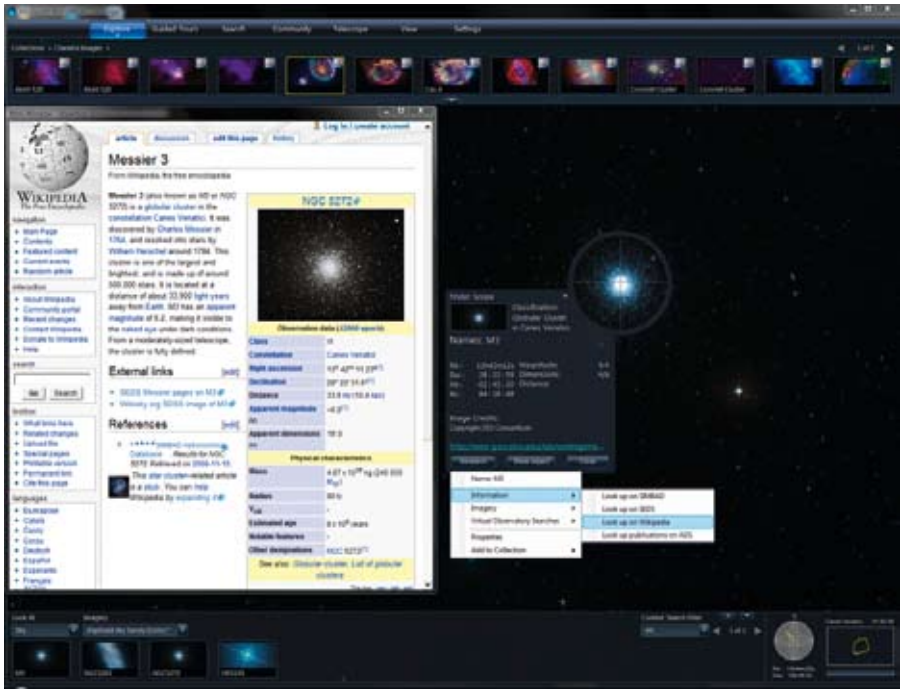

Figure 2. Screenshot of retrieved information on Messier 3 from Wikipedia. Credit: WWT.

The WWT has an integrated easy-to-use authoring environment that allows the novice to create guided tours of the Universe easily, using images of galaxies, nebulae, star clusters or other objects available within the WWT from any telescope, view or wavelength. It includes text, graphics, music, narration and other resources to enhance the experience. While the tours resemble video sequences, they are totally interactive, allowing the user to pause the tour and examine any detail of an object, to delve deeper into the information or simply to continue the tour.

All objects within the WWT have dynamic links to related source information, databases and source images that can be retrieved using simple menu choices. This seamless integration of tours, contextual exploration and dynamic links between objects and source information is based on the Contextual Narrative information architecture described in this paper.

Information Architecture

Contextual Narrative (CN) is an information architecture that has been developed and refined over the past 17 years as a model for creating engaging learning environments. CN consists of the following three linked layers.

Figure 3. Screenshot from the Spitzer tour of Messier 81. Credit: WWT.

Stories

CN seeks to engage new learners through storytelling. Stories can engage the subject in a way that piques the curiosity and leads the learner into previously unknown subject areas, motivating them to go deeper into the linked Exploration layer.

Exploration

Stories told within the Exploration layer allow the user to engage interactively with the subject matter in multiple contextual ways. This Exploration layer can provide spatial and temporal simulation and other interaction models to help develop mental models that provide a framework for understanding accessed via different learning modalities.

Source Information

Objects in the contextual Exploration layer are linked to the Source Information layer, which provides the data that validate the new mental model. By providing a seamless link between stories, exploration and information, the user is drawn more quickly into a learning process that supports various learning modalities and constructs a framework for understanding.

Stories

- The focus of this CN environment is to engage the user and draw them into the subject matter. This is particularly important if the user is unfamiliar with the topic or is initially not particularly interested. The first narrative should establish a reason for the person to care about the subject.
- A framework for organising and remembering information about the topic is established. This has been the technique for preserving historical information since before recorded history. Stories were often memorised using songs that provided another memory augmentation mechanism to strengthen recall and structure large amounts of information.
- New stories can be created within the WWT using text or narration with music to introduce new topics and provide a framework within which to retain newly learnt information.
- Stories in the WWT take the form of Tours. These may be as simple as a PowerPoint presentation with text and graphics set within the virtual sky with automatic transitions between objects, surveys and study images. Tours can be created easily and shared as a file that can be played back by others using the WWT.

Figure 4. Contextual Narrative information architecture. Credit: Courtesy of the author.

- Stories are loosely clustered by domain, similarity, or by level (simpler narratives and overviews tend towards the top, whereas more specific, complex and deeper narratives on specific topics tend towards the bottom of this layer). Existing ontological organisation of the narratives may be useful to communicate the nature of the kind of narratives that are present, but the nature of Contextual Narrative is to enable deep cross-linking between related content so that pre-defined ontological relationships between content are just the beginning of the potential linkages.

Exploration

In the WWT the Exploration layer setting can be a virtual sky that explores a way to communicate spatial information related to the angular size or distance for objects within the sky. Stories from the layer above might be deconstructed or directly linked to objects so that the user can hear stories relevant to the object, much like audio guides in an art museum. This process of integrating stories within the environment establishes a spatial link between the stories and the context of that object, as well as providing a mental model and connection between stories, spatial information (size, location) and other associations for that object, such as another nearby memorable object. This process facilitates the development of a dimensional mental model of associations between stories, size, proximity, location and other contexts that will assist visual learners.

Figure 5. Screenshot of a hydrogen-alpha view of the constellation Cygnus. Credit: WWT.

Figure 6. Cross-fade to an X-ray view of Cygnus. Credit: WWT.

Within the WorldWide Telescope the Exploration layer consists of multiple sky surveys of different wavelengths and study images that are all registered in the virtual sky with high precision World Coordinate System metadata. The complete sky can be browsed in multiple wavelengths such as visible light, H-alpha, 2 Micron All-Sky Survey, X-ray, radio and others. Sliders can cross-fade between discrete wavelengths to compare objects and structural details that depend on wavelength. Detailed high resolution multi-wavelength study images from many telescopes are also available for each object. All of these resources are available for inclusion in a potential tour.

The process of interactive exploration within a virtual sky reinforces spatial associations between stories and objects and can directly map to an understanding of the real sky.

This has been demonstrated anecdotally with children who have used the WorldWide Telescope and then gone out under the real sky. They often point out familiar constellations and recall the location, presence and stories about an object that they are familiar with from WWT even though the object cannot be seen with the naked eye. The purpose of the Exploration layer is to assist in the development of contextual mental models through interaction and elaboration of topics of interest raised by the stories. Stories told within the middle Exploration layer are such that the information from the stories can be retained in context.

Source Information

The purpose of the Source Information layer is to enable users to access source information about objects within the exploratory space easily.

Figure 7. Screenshot of Messier 31. Credit: WWT.

- Source Information within the WWT currently links to Simbad, Students for the Exploration and Development of Space, Wikipedia and astronomical databases of published papers, such as the Astrophysics Data System.
- The WWT also automatically provides links to retrieve a source image from DSS or SDSS as a JPEG file or a FITS file for specific objects.
- Other sources of information about objects can be added to the Source Information links in the future.

The WorldWide Telescope was designed with this information architecture to engage the curious by telling compelling stories. The stories link seamlessly between new and unfamiliar objects and areas in the sky and allow users the freedom to explore with the full resources of the WWT (multi-wavelength, multi-resolution, multiple telescope studies) coupled with links to deeper information resources from around the world. This allows new users to engage with the subject matter through the directed experiences of the tours and then branch off to self-directed experiences that allow them to go as deeply into the subject matter as they choose.

Rich though the WWT is, with its multiple terapixel multi-resolution image surveys linked to source information, the real power of the WWT will come when more and more stories are created within this environment that crosslink and form a hypermedia web. That web of stories will eventually allow people to move through the stories as easily as they move through hyperlinks on the web today and allow stories about the Universe to be created and shared.

Conclusions

The WWT was launched on 13 May 2008. Initial users of early versions have reported a high level of engagement among children of all ages and promising levels of retention based on the CN model. Once the application is established it will be interesting to conduct more rigorous, in depth and controlled studies of student comprehension of astronomy before and after using the WWT in contrast to other non-interactive media.

Notes

1. 1991: *Multimedia Beethoven*/Microsoft, 1995: *A Passion for Art*/Corbis, 1996: FDR/Corbis, 1997: *Leonardo da Vinci*, 1999: ArtMuseum.net/Intel, 1999: *Frank Lloyd Wright~The Poetry of Structure*/Ken Burns|PBS, 2002: *Commanding Heights*/PBS|WGBH|Microsoft Research, 2006: Frontline~*The Age of AIDS*/PBS|WGBH|Microsoft Research

Biography

Curtis Wong is the Principal Researcher of the Microsoft Next Media Research group responsible for future interactive media technologies to enhance the consumer media experience. His work has won numerous awards, including a 2002 British Academy Award and the first ITV Emmy nomination, four New York Festivals Gold Medals, and CA & ID awards. Curtis currently serves as a Trustee for the Seattle Art Museum and the Rhode Island School of Design, a member of the PBS Kids Next Generation Digital Media Advisory Board. He has previously served on the Advisory Boards for Ovation — The Arts Network, PBS Online, the Corporation for Public Broadcasting, the National Constitution Center, the Canadian Film Centre and the American Film Institute.