IBook: Interactive and Semantic Multimedia Content Generation for eLearning

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Abstract

Over the years the World Wide Web has seen a major transformation with dynamic content and interactivity being delivered through Web 2.0 and provision of meaning to Web content through the Semantic Web. Web 2.0 has given rise to special methods of eLearning; we believe that interactive multimedia and semantic technologies applied together can further enable effective reuse of such applications thereby taking eLearning a step further. As proof of this idea we present IBook which is an eLearning application that uses concepts from both the fields of Web 2.0 and Semantic Web. It presents multimedia in a form that enhances the user's learning experience through the use of Web 2.0 and Semantic Web.

Keywords: *Web 2.0, Semantic Web, Multimedia, eLearning.*

1. Introduction

With a proliferation of Web 2.0 services and applications there has been a major paradigm shift in the way we envision the World Wide Web [3, 4]. We have witnessed an evolution of the Web from the first generation to the third generation [1, 2] and at present we live somewhere between the age of second generation and third generation Web content. This age can be termed as a "transition stage" between Web 2.0 [3, 4] and the envisioned Semantic Web [5] and in this transition phase there has been a realization of new concepts such as e-Science, e-Education, e-Learning, e-Commerce, e-Government etc.

The realization of these new technologies has given birth to new forms of multimedia in the World Wide Web and this is in particular the case with eLearning [6] with many adaptive hypermedia learning applications being developed. This paper also presents one such application IBook and what sets it apart from other similar works are its additional features of interactive multimedia content facilitating effective learning with semantic technologies i.e. XML[7].

IBook is an application that takes an innovative approach for eLearning which lies in both domains: Web 2.0 and the Semantic Web. Linear text was challenged by the world of the Internet which led to the creation of hypertext but even that suffered some drawbacks which led to the concept of hypermedia [9]. The students of today have done away with books and look to the Internet to support their learning. A widespread argument now exists among teachers, educators and psychologists that advanced comprehension is acquired through interacting with the content [8] and this is the fundamental motivation behind IBook. We feel that semantically connected data in multiple dimensions can bring a remarkable change in the learning curve and experience and this is where IBook plays its role.

As is clear from the name IBook is an interactive, multimedia based book which provides the reader with additional forms of presentations for enhanced delivery of the book's contents. Moreover the book not only follows its classical front view but also possesses great details to explain it further by adding relevant video content as well as voice over feature to retain readers' attention to the most. Hence IBook is an advanced multimedia platform for eLearning. With IBook the educator can add flexibility and easy adaptation to new and changing user requirements through support for a reusable metadata structure.

The remainder of this paper is organized as follows: section II explains the necessary background with respect to the generations of Web content, section III explains in detail the IBook features and functionalities with illustrations. Section IV presents the architecture and implementation details of the IBook framework with an overview of how semantic technologies are incorporated into it. Section V concludes the paper with a discussion of possible future works.

2. Background

As mentioned in section I IBook is an application from the areas of Web 2.0 and Semantic Web and this section provides a brief overview of each of these areas.
Some researchers characterize the Web evolution in terms of generations with the first generation containing static HTML content [1, 2] which was and is still being replaced by dynamic, on-the-fly Web content giving rise to the second generation of Web technologies and applications [4]. Second generation Web technology mainly focused on addressing needs of humans but in contrast third generation Web technology is more focused at making content that is machine-processable.

2.1 Web 2.0

The term Web 2.0 stands not for a system but a design philosophy applied to the first generation Web content and with application of this design philosophy emerged a whole new range of applications which facilitated interactive information sharing, interoperability, user-centered design and collaboration on the World Wide Web. Web 2.0 applications include a whole new array of applications some examples being social networking sites like Facebook and MySpace, video sharing sites like YouTube, wikis, blogs, mashups and folksonomies [14].
The fundamental idea behind Web 2.0 is the use of the "Web as a platform" with software applications moving from the desktop to this easily accessible platform enabling rich interaction and user participation – the two things we also bring into IBook.

2.2 Semantic Web

The Semantic Web is the third generation Web platform which is more focused towards meaning of information and services on the Web making it possible for machines to process the content in order to enhance the user experience. It is more of a vision of the early pioneers of the World Wide Web and this vision sees the Web as a universal medium for data, information and knowledge exchange [10]. It proposes markup of content on the Web with the help of formal ontologies for structuring of the underlying data for the purpose of comprehensiveness and machine understanding. The Semantic Web is an extension of the current Web in which information is given well-defined meaning, enabling computers and people to work in co-operation.

2.3 Integration of Web 2.0 with the Semantic Web

Earlier when O'Reilly Media and MediaLive hosted the first Web 2.0 conference in 2004 and the term "Web 2.0" was used the inventor of the World Wide Web Sir Tim-Berners Lee discarded it as being a "buzzword" or "piece of jargon" but recently some researchers have presented a different viewpoint [11, 12, 13]. Researchers are now talking about a merger of the two ideas of Web 2.0 and the Semantic Web and are now upholding the belief that the two fields are "complementary rather than competing with goals being in harmony and each bringing its own strength into the picture" [11]. This is also the line of reasoning we follow in this paper and advocate the idea of integration of Web 2.0 technologies with the Semantic Web ideas for effective methods of eLearning.

3. IBook Features and Functionalities

We now present a high-level view of IBook describing its features and functionalities in detail.

This section mainly contains a description of the features through that IBook can support and the implementation details are explained in the next section.

The programming platform used was Adobe Flash with Action Script 3.0. Figure 1 presents the front end view of IBook:
Broadly viewed we can define IBook features in terms of following characteristics of the Web 2.0 and the Semantic Web:

- Non-linear Textual Nature
- User Interactivity
- Multimedia Support
- Content Personalization and Reuse

3.1 Non-linear Textual Nature

The innovations in Web technology have refined the traditional use of the book adding to it the dimension of random access rather than linear, sequential access. This is what is also supported in IBook. As mentioned in the introduction IBook presents the content of the book in its classical format with the added feature of having hyperlinks to each chapter. This eases the process of

navigating into the book for content and gives the user an extra level of interactivity which closely mimics the real-world book as shown in the table of contents view shown in Figure 1. When the user clicks a particular chapter for viewing he is presented with the view shown in Figure 2. Here the reader is not only able to read the chapter's contents but can also listen to it with voice over feature: as soon as chapter opens the text of the chapter is played with the portion that is being played highlighted in yellow. The voice over facility is what makes IBook particularly unique and sets it apart from other works in the eLearning domain: this is the first such work which gives user an extra level of multimedia interactivity with voice over capability thereby being able to grasp his attention towards the content of the book. The reader is also given the capability to stop or pause the audio at any point thereby adding interactivity to the reading/listening process. Navigation features are also included within each chapter of IBook while the reader browses through the book.

Figure 1 IBook Front View

3.2 User Interactivity

IBook also contains additional features to enable user interactivity in order to facilitate deep comprehension of the subject; these features incorporate the facility to check if the user understands the chapter's contents through chapter quizzes and enhancement of that understanding through video summary of the chapter. The first quiz as shown in Figure 3 is termed "Linkage Activity" and asks user to match the correct terms with each other by drawing a line between them and the second quiz as shown in Figure 4 is called "Drag and Drop Activity" and it asks the user to fill in the appropriate boxes with the connected terms by dragging and dropping. These quizzes are included in each chapter and test the user's knowledge of the chapter's content hence enhancing the user interactive experience and providing more efficient concept delivery. These quizzes can be user-defined and how this is achieved is explained in detail in the next section.

Figure 2 IBook Chapter View

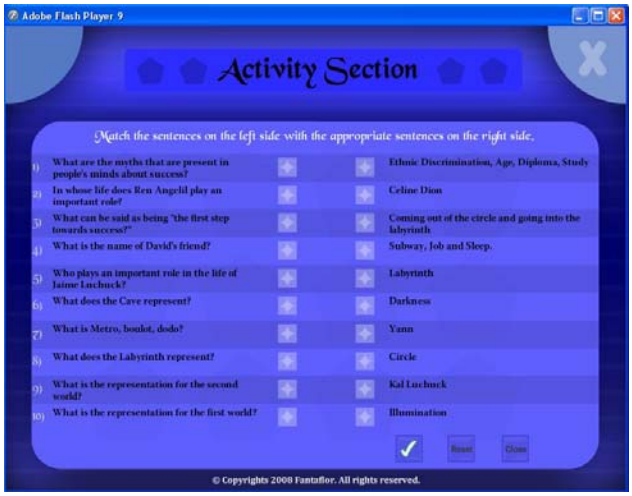

Figure 3 Quiz 1 Linkage Activity

3.3 Multimedia Support

Another useful feature provided in IBook is the concept of video summaries corresponding to each chapter; an illustration is presented in Figure 5. As the figure shows when the user clicks on the video summary button a popup video appears which summarizes the contents of the current chapter in video form. Like the interactive quizzes the video summary can be user-defined and supports rich user-defined semantics as explained in the next section.

Hence we can see that IBook provides a complete multimedia platform with audio, video, images and interactive content to enhance the user's learning experience which sharpens the learning curve greatly.

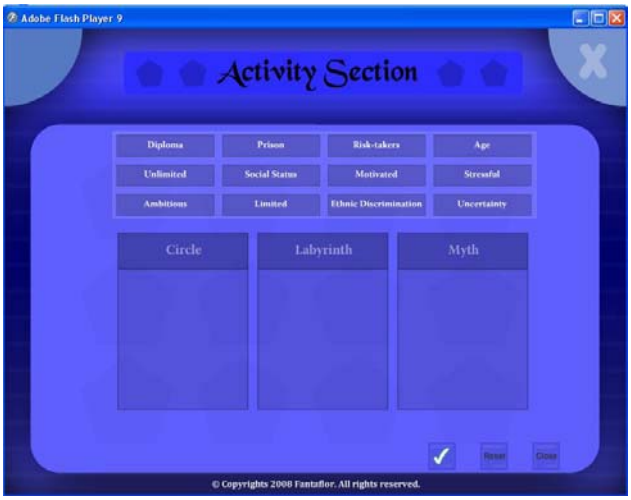

Figure 4 Quiz 2 Drag and Drop Activity

Figure 5 Chapter Video Summary

3.4 Content Personalization and Reuse

One of the key aspects of the IBook system is the ability to support personalization of the book's content. As mentioned in the Introduction Web 2.0 enables rich dynamicity into Web content and this is what we have taken advantage of for IBook: the content and the underlying structure are stored separately from the details of presentation of that content and this enables effective adaptation of the content to specific needs of users. In addition to personal adaptation the dynamic nature of Web 2.0 enables effective reuse of the underlying structure and this reuse has been enabled largely with the help of Semantic Metadata standards

4. IBook Framework and Architecture

This section explains the architectural framework of IBook. As explained in earlier sections IBook uses technologies from the domain of Web 2.0 for interactivity and Semantic Web for reusable, user-defined content support through metadata standards.

4.1 High-Level Architectural View

Figure 6 depicts the high-level architectural view of IBook. The semantic module is basically composed of three parts with the first part describing the book's text and audio content, the second and third part contain metadata and user-defined semantics for video summary and the quiz activity.

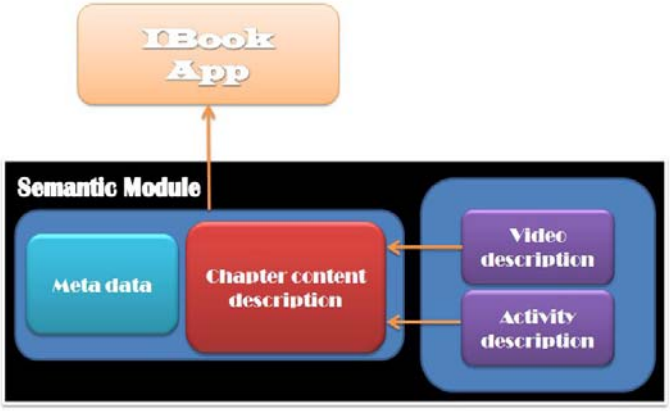

Figure 6 IBook High-Level Architecture

The module for video summary and quiz activity is kept as a stand-alone for the purpose of greater flexibility. This also has the added benefit of using these modules independently i.e. creation of video content as a standalone video presentation or creation of quiz activities as standalone quizzes. We now explain each of these modules in detail.

4.2 Semantic Metadata Module

The module for managing the metadata uses the semantic technology to facilitate user-defined content creation and reuse of that content. XML is also a widely used standard for Web 2.0 development designed for markup in documents of arbitrary structure. For each part of the IBook we use XML specification which makes the content machine-processable and adds descriptive information about the IBook resources for purpose of finding, managing and using them more effectively.
The XML portion for each chapter is shown below:

```
<book>
  <toc>
    <Title>Book Title</Title>
    <Heading>TOC</Heading>
    <data>
    <![CDATA[Chapter Contents Here]]>
    </data>
    <image>TOC Image</image>
    <audio>TOC Audio</audio>
    <pos>Audio Positions</pos>
    <pos>Audio Positions</pos>
    <pos>Audio Positions</pos>
  </toc>
  <content>
    <Title>Chapter 1 Title</Title>
    <Heading>Chap Heading</Heading>
    <data>
    <![CDATA[Chapter Contents Here]]>
    </data>
    <image>Chapter Image</image>
    <topicAudio>Audio</topicAudio>
    <audio>Chapter Audio</audio>
    <videoTitle></videoTitle>
    <pos>Audio Positions</pos>
    <pos>Audio Positions</pos>
    <pos>Audio Positions</pos>
  </content>
  <content>
    .
    .
    .
  </content>
</book>
```

Table 1 XML Specification for IBook

As is clear from this XML structure the <toc></toc> nested part specifies the contents for the table of contents of the book: including the image for table of content, heading and audio for voice over. Similarly the tags for content i.e. <content></contents> allow the user to give specification for chapter's audio, images and video summary title. The <pos> tags specify the cue positions for the audio that is played with the highlight feature; these positions mark the positions of sentences in the audio and decide when the next sentence is to be highlighted. As this structure shows the user can fill the IBook with his changing data and can also specify many other features of his choice.

In a similar manner the quiz activities along with its questions and answers and the video summary can be specified through XML tags based on each chapter's contents. The video summary is basically an animation made up of a sequence of images with effects in between; also there is the additional capability of using text in between the moving images for description. The video module is basically a stand-alone multimedia presentation generation system which combines text and graphics in real-time enabled through XML metadata specification.

This semantic module provided by IBook enhances the user's experience with multimedia interactivity and hence replaces the traditional book concept.

4.2 The Web 2.0 and Semantic Web Experience

The Semantic Web takes the Web experience further by making transforming computers from a passive entity to an active entity in the process and offers a generic infrastructure for interchange, integration and creative reuse of structured data: these features of the Semantic Web can help it overcome the problems and limitations of the current Web 2.0. As demonstrated by IBook adding semantics to Web 2.0 provides more reuse possibilities and creates richer links between content items: audio, video and interactive quizzes in the IBook case. We further advocate the case presented in [11]: 1) using layers of Web 2.0 to lead towards the Semantic Web dream and 2) using semantic technologies for providing a robust and extensible basis for emerging Web 2.0 applications.

4. Conclusions

The collaboration between Web 2.0 technologies and Semantic Web technologies can give birth to exciting, interactive applications. We experimented with the idea and developed one such eLearning application IBook which introduces how enhanced learning can be delivered through modern Web technology. The future works for this application include extension of the semantic technologies to make it closer to be realized as a Semantic Web application and one example of this can be incorporation of semantic search technology within the book framework. Another significant future extension we plan for IBook is the automation and ease of use for the content generation process for IBook which at present is manual.

All in all we believe applications like IBook are a significant move towards the envisioned "Semantic Web" which is likely to become a reality by efficient and effective use of Web 2.0 technologies.

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