AC 2012-4468: THE NEW E-TEXTBOOK: FLIPPING THE PAGE TO A NEW PARADIGM

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Abstract

Electronic textbooks are different from e-books in that they allow the user to go beyond just reading material on a computer screen. E-textbooks encourage the user to perform all of the operations typically performed with a hardcopy text in addition to some functions not possible with paper books. With e-textbooks users can annotate in the text with e-ink, mark important sections, search over the e-ink, the text or even the scanned images, look up items in online dictionaries or encyclopedias, perform interactive reinforcement drills, view simulations, and many other operations afforded by the computing power of the underlying computer and the reach of the Internet connection.

This project works to implement an e-textbook with as much capability as possible using software tools that are already in place. Although standalone e-readers have been built, most do not provide the features necessary to improve upon the traditional paper reading experience. The e-textbook add-in seeks to improve OneNote's capabilities as a reader, especially on tablets and slates, while leaving in place its strengths in note-taking. The add-in also looks to simplify the transition from traditional publishing formats to the OneNote format.

This paper will describe the operation of the new e-textbook, it will discuss the implementation of the e-textbook add-in for OneNote, and it will talk about the user experience for those who employ the tool. We will also provide information on how the e-textbook will be evaluated in terms of its effectiveness in improving the engineering student study experience

Introduction

Electronic book readers, such as the Amazon Kindle, have become a valued alternative to paper books due to their light weight and ease of use. The Kindle and other e-readers have achieved a foothold in the publishing industry. However, there has not been a product to similarly establish itself as a replacement of paper textbooks. While the e-readers currently available have some merit for use as e-textbook readers for the same reasons they work for eBooks, to be a viable replacement for traditional textbooks, a product must meet requirements not found with regular books and should have added utility. The product must also strike a balance between publishers' business models and the students' budgets.

e-Readers today are not easy to use in a studying environment nor do they provide further enrichment. As a student studies from a textbook, he will likely need to see more than one page at a time and take notes. The ability to have non-consecutive pages from multiple sources available at the same time is not provided by any device. Note-taking on e-readers is typically a challenging prospect due to small keyboards or other similar factors. Further, e-readers do not necessarily provide access to the web for further learning or the ability to play media such as recorded lectures and demonstrations. Also, neither e-readers nor paper books provide tools to

improve a student's ability to learn from a lecture. This paper discusses a tool which attempts to provide an enriching e-textbook experience while addressing the needs of the student and publisher by meeting and surpassing current experiences.

The e-textbook add-in for Microsoft OneNote provides a solution for replacing paper textbooks. While using OneNote assumes students already have a Windows laptop, preferably a tablet or convertible for inking, available, the PC and OneNote provide many useful features out of the box. The add-in simplifies and facilitates many actions a student would likely perform during lectures and reading. The user can take notes directly on the book or insert pages and even chapters for taking his/her own notes from lectures or other sources. By using a convertible laptop, a student can easily switch between using a stylus or the keyboard for taking notes as the information changes. Also, by using OneNote's built-in audio and video recording, a student can record entire lectures and embed them directly into the page alongside their notes.

Background

Tablet PCs have slowly found their way into more and more classrooms. Tablet PCs are portable computers which feature digitized ink capabilities via a stylus which can also replace a mouse. While some tablets feature a screen which rotates to cover the keyboard (referred to as convertible tablets) allowing the user to switch between a traditional laptop form factor and a slate form factor, others do not include a keyboard at all, these are sometimes referred to simply as slates. Windows Vista and 7 have built in support for tablets out of the box, while Windows XP tablets ship with a special version of the OS enabling pen and touch-based computing.

Tablet PCs can be harnessed to improve a student's classroom experience. Note-taking is improved by the use of tablets as a student may draw their own figures and equations into their digital notes, a cumbersome task with a keyboard and mouse. The ability to write freeform notes was identified by a 2007 study at Darmstadt University of Technology as the most important factor for students who chose to continue using paper instead of computers for note-taking[1]. The search capabilities built into OneNote also allow a student to easily find keywords in their notes, even in handwritten sections using optical character recognition capabilities built-in to the software. A student may easily markup slides and receive presentation edits immediately during a lecture if the instructor is using a courseware package such as Interactive Classroom[2], DyKnow[3] or Classroom Presenter[4]. When coupled with the advantages of traditional computing and note-taking, tablet PCs show a distinct advantage to students in and out of the classroom.

A number of tablets with Windows 7 are available from various manufactures such as Dell, Hewlett-Packard, Acer, Fujitsu, and Lenovo. Dell features a convertible in their Inspiron line as well as a slate in the Latitude line. HP features the Slate 2 which is comparable to the Latitude. The Dells and HP devices feature the Atom processor and are similar to netbook computers. The Acer and Lenovo devices feature 14 inch and 12.5 inch convertible tablets, respectively, with Core i3/i5/i7 processors which may be well suited for a student who does not want to own a

separate computer to provide a more traditional experience as it is more akin to a laptop in power and form factor than a netbook. These options all start around $700 to $1000.

Utilizing tablets, along with software such as Microsoft OneNote, allows students to reduce the number of traditional notebooks they carry while remaining more organized. OneNote allows users to create digital notebooks which can contain inked and typed notes, images and embedded files including recorded audio and video. The notebooks include cascading sections which can contain pages allowing for a well-organized book. Each page can be customized with various options, such as ruling and page backgrounds, and can be expanded infinitely in any direction. Pages can also be moved and copied into other sections. Essentially, OneNote's intended purpose is to match and surpass the capabilities of traditional paper and pen note-taking.

Note-taking, and particularly complex note-taking using complete considered thoughts, is particularly important for student achievement[5]. A higher quantity of notes correlates with higher achievement. This can be a problem in cases where students are slowed by the capabilities of a device's input interface or are manipulated into fewer and shorter sentences and ideas by a smaller screen. For instance, in a study in 2004, students using personal digital assistants using graffiti input were found to learn less during note-taking and reviewing notes compared to students using Tablet PCs with stylus and those using paper and pen[6]. Even the users who used the PDA's free from input tended to have shorter less complete notes than their counterparts. In the two cases students who did not perform as well faced challenges which hindered their abilities to either write complete thoughts or were slowed due to the interface which resulted in fewer notes. OneNote users on Tablet PCs should not face these problems due to the breadth of capabilities in OneNote, though a poor stylus interface or screen may reintroduce these or discourage tablet use.

A wide variety of acceptable page content allows users to take notes in ways that cannot be done in a traditional notebook. OneNote includes a mechanism for recording audio and video, assuming a microphone and camera, which is stored on the page for later playback. Any file can be embedded in the page for storage while leaving a link on the page to get to the file quickly and easily. OneNote also allows for quickly inserting printouts from outside files right into the notebook. A myriad of pen and highlighter types available to the user provide an experience similar to traditional note-taking. When writing notes via a stylus, OneNote runs optical character recognition to allow handwritten notes to be searchable. The search capability can search all of the user's notebooks including handwritten notes, typed notes, and images with text, including scanned handwritten notes. With this, the user can quickly and easily locate notes they could have written in the past compared to searching through traditional notebooks. These abilities address other important factors identified in the Darmstadt study, freeform note-taking, long term storage, and electronic search[1]. The study also mentions that two thirds of students who use a computer for note-taking simultaneously use paper. Because OneNote allows for inserting and searching on scanned handwritten notes, students who choose to use paper for the flexibility can still use OneNote for its abilities in storage and electronic search.

Related Work

E-textbooks have received increasing attention over the past decade. Some of the other platforms considered for displaying e-textbooks include the Amazon Kindle DX, particularly since Amazon conducted a pilot study in 2008[7]. The study took place at a number of schools, including Reed College with the intention of evaluating the Kindle DX as a replacement for paper textbooks[8]. Some of the successes and positive aspects found during the study at Reed College included the legibility of the displays, the form factor including the size and weight, the long battery life, the durability, the paper savings, the wireless distribution system, and the lack of distraction in class settings as the Kindle has a limited number of distracting features. While the positives list is long, there were still a number of issues listed, including acquisition of texts for the Kindle; missing PDF capabilities such as annotation, highlighting, and text-resizing; distribution of reading beyond the course texts such as those from journals; poor image display due to lack of color and low resolution; lack of organizational hierarchy for files; slow page turning; speed of method to change to specific locations in the book; speed of method to change between books; difficulty of taking notes in the book; and missing features for proper accessibility for the visually impaired. This study provides a proper baseline for moving forward in developing a new iteration of e-textbooks.

A study was done by the Workshop on the Impact of Pen-Based Technology (WIPTE) to identify aspects important for an e-textbook to enhance pedagogical practices[9]. The identified aspects include electronic inking and highlighting via a stylus, multimedia access and playback, embedded simulation, text to speech, internal and external searches including ink, self-updating content, collaboration between students, individualized tutoring and assessment, and drill-down capability. Quick access to audio, video, and interactive simulation, whether stored on the device or the internet, can provide a student with a better explanation than what is possible with text. Internal and external searching can hasten and ease finding answers and expand content exposure. Collaboration would allow students to work together to explain complex problems more easily. Individualized tutoring and assessment and drill-down capability allow a student to work one step at a time. By doing this, a student can master the simpler concepts before proceeding to more difficult concepts in a way that will allow quicker and fuller learning and understanding.

The Kno tablet was a planned device with the idea of replacing paper textbooks central to the design. The two different versions included one or two large 14.1 inch touch and stylus enabled screens which were hinged together to look similar to a book. The Kno would have allowed connection to a Bluetooth keyboard for quick typed note-taking. There are a significant number of textbooks available for the Kno which typically sell at half the cost of their printed counterparts. The Kno included support for Google Docs and Office Live along with PDF support. A software development kit based on the popular WebKit library was also planned. The software included a textbook reader, notebook with features similar to OneNote, and a web browser. However, the project was cancelled in favor of developing only software in April 2011.

Kno, as the company is also known, still produces web-based e-textbook software and has a library of 100,000 e-textbooks.

CourseSmart is a joint effort by publishers Pearson, Cengage Learning, McGraw-Hill Education, Beford, Freeman & Worth Publishing Group (Macmillan) and John Wiley & Sons. They have 20,000 e-textbooks available for use on any Windows, Android, or iOS device although with some limitations if the device is not connected to the internet.

E-Textbook Add-in

The e-textbook add-in for Microsoft OneNote attempts to increase the viability of OneNote to perform as an educational tool beyond note-taking. The add-in includes many tools to make OneNote work like a traditional book while adding many features only possible with a computer. These features improve both the individual study and lecture experience. The add-in also looks to make it easier for publishers to convert traditional books to the electronic format. The guiding principle is to include many of the suggestions provided from WIPTE and address the concerns from the Reed College Kindle study.

The primary function, displaying the book, includes mechanisms for displaying multiple pages on one screen, while allowing the user to decide what pages are displayed in each window. The user can elect to have two windows side by side. Then, a second window is opened if it is not already and the two windows are resized to split the screen equally automatically. The user can have the pages synchronize so that changing one page changes the other page to the next, or previous depending on which window is changed, consecutive page. These two windows can be desynchronized to allow the user to choose pages from two different books or simply pages from different parts of the same book.

The add-in also includes a feature to improve note-taking particularly when more than one OneNote window is open. As a window must have focus before note-taking can begin, switching between windows can become cumbersome as the user must first tap in the right window then start writing which is unnatural. The add-in rectifies this by switching focus to the window the stylus or pointer is hovering over. By doing this, the focus has already changed by the time the user beings to write.

To improve the ease of use on touch screens and to increase the screen real estate dedicated to content, navigation controls have been optionally added to allow easy flipping of pages and navigating through page content while reducing the amount of screen statically allocated to navigation. This allows the user to switch OneNote into full screen mode, which hides the standard interface, to allow more space for content while not sacrificing many of the necessary controls. These added navigation controls include page forward and backward for either window depending on whether or not the pages are synchronized, ability to change to other pages in the current book and a table of contents accessible through a few quick mouse or touch movement which includes all books. The page forward and back controls, as shown in Figure 1, are located

at the bottom left and right of the screen to provide a comfortable interface for the reader on a tablet. These controls also move as the window is resized as shown in Figure 2.

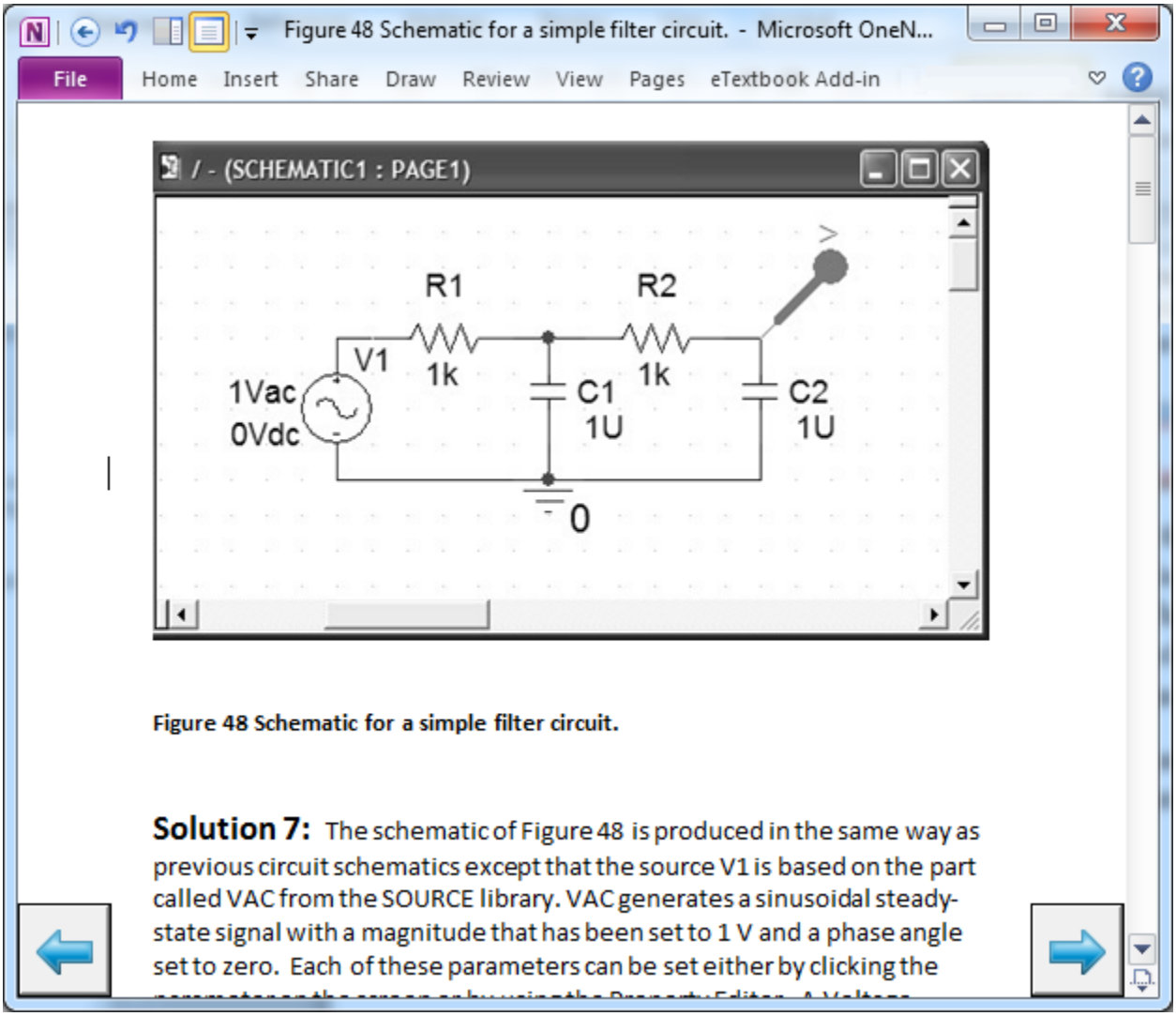

Figure 1 OneNote e-Textbook Add-in showing navigational controls.

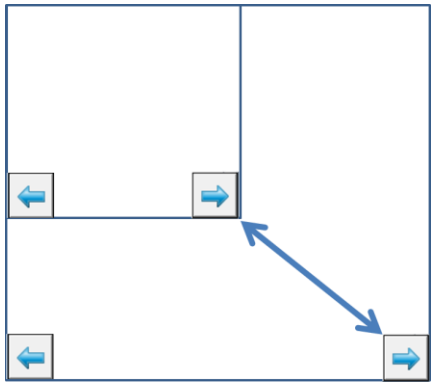

Figure 2 Control positions are synchronized with the window size.

While OneNote includes a quick search for searching the contents of all books, the add-in includes abilities to search keywords on the internet via Google, Yahoo!, and Wikipedia. This feature will open a window in the default browser. While not a feature of the add-in, OneNote already includes capabilities to include multimedia, including audio, video, and executables, on the page which is easily accessed by the user which can eliminate the need for bundled discs. The quizzing mechanism, shown in figure 3, of the add-in utilizes the embedded file capabilities of OneNote to store quizzes which are displayed by a program included with the add-in.

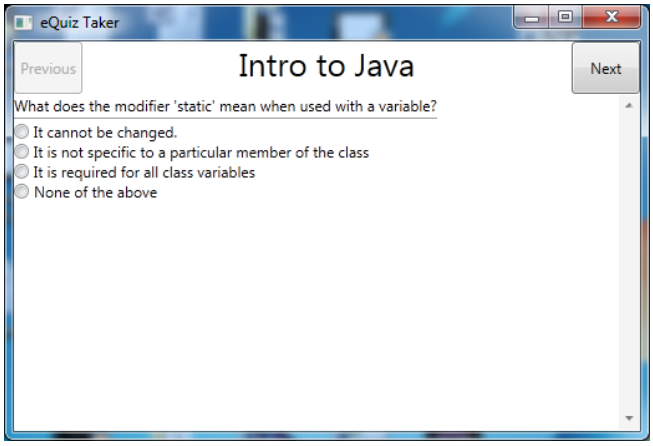

Figure 3 Screenshot of the quiz-taking program built into the add-in.

Because OneNote allows pages to expand limitlessly and be added in between previously created pages, a user can take notes during a lecture directly into their book on the exact pages or on an added page in the correct chapter. The user can also record audio and video from the lecture directly into the book. Figure 4 shows a book with student notes and highlights in the book layout view. The add-in also does not interfere with other add-ins such as Microsoft's Interactive Classroom, which provides a lecture-time note and slide sharing mechanism for students and teachers.

With the add-in installed on their tablet PC, a student will be able to have all notes and all textbooks available in one place. By utilizing notebook sharing built-in to OneNote with Microsoft Office Live or other services, the books and notes can be accessed anywhere at any time. Pages can also be printed out for times where an electronic device is not sensible. The ability to have all class information available on one device greatly reduces the physical load a student must carry. Also, due to the highly customizable setup, students can organize their notes as they wish, for instance, by lecture, chapter, or exam. The add-in adds and simplifies features which give OneNote added potential as a conduit for e-textbooks.

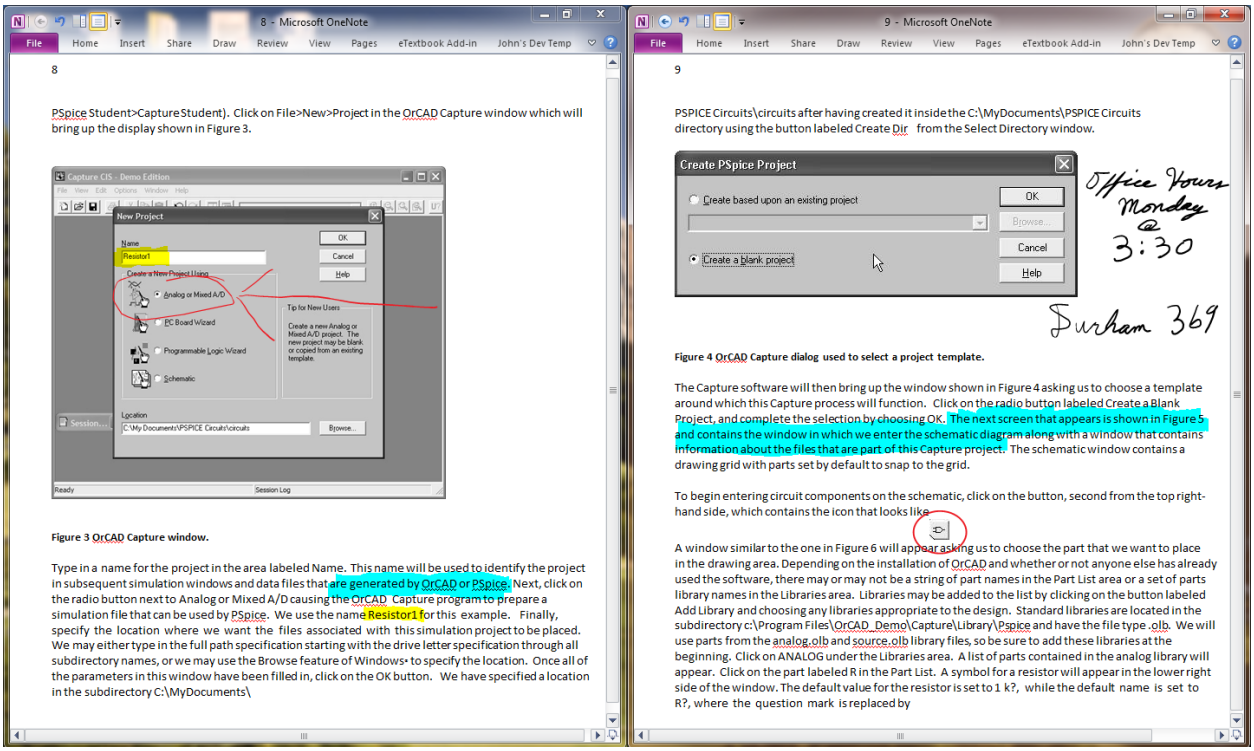

Figure 4 Two pages of a book showing student notes and highlights.

The add-in also looks to ease the process of converting current texts to the OneNote format. It has been designed to import rich text format files, particularly those created by Adobe Acrobat Professional, into OneNote while attempting to preserve formatting. The tool keeps the process, shown in figure 5, easy for the publisher. The importer is capable of loading text, table, images, and shapes from RTF documents. The importer can also import PDFs directly; however, this includes only an image of the page rather than the original content.

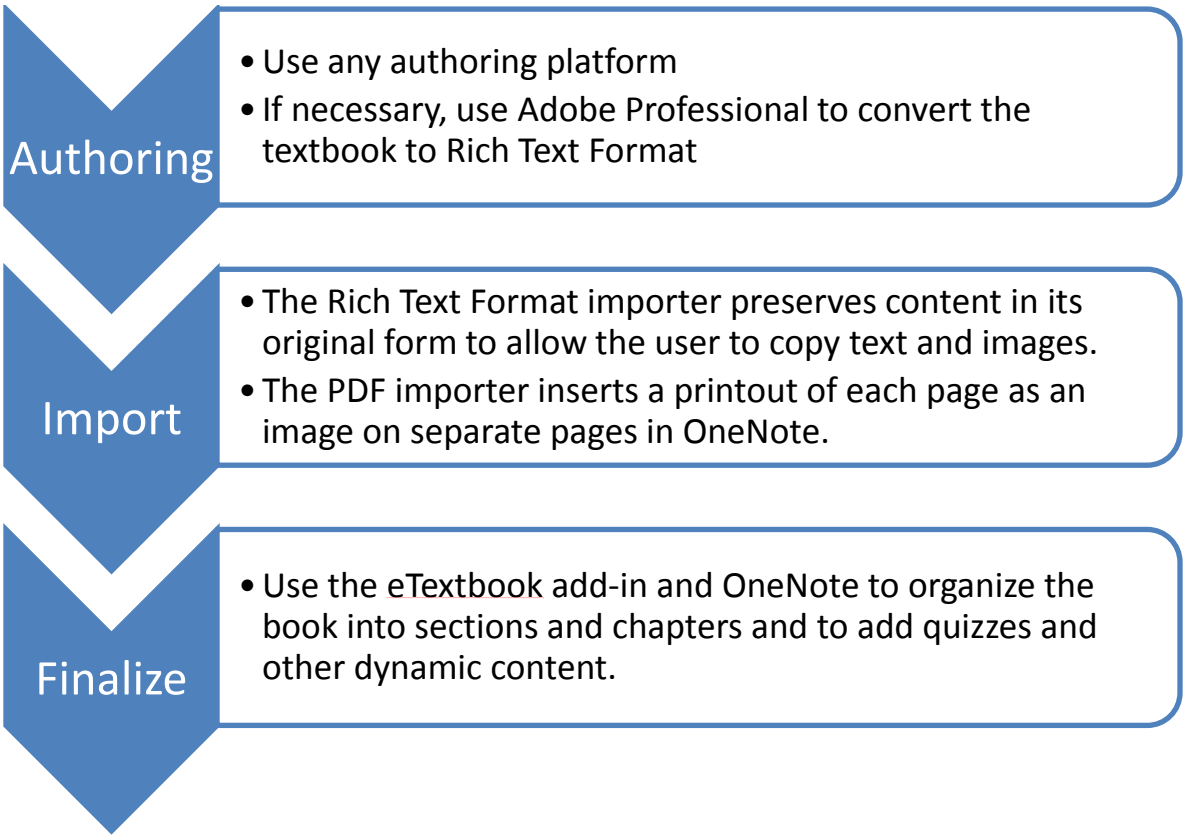

Figure 5 The book design process.

Implementation

The code runs on Microsoft's .NET framework and interacts with OneNote through the COM Interop Services. The most recent version, four, of .NET is used. The Visual Studio Tools for Office package while useful for rapid development of add-ins does not support OneNote. The add-in also uses Microsoft's Fluent User Interface for adding to OneNote menu's as well as the Windows Presentation Framework (WPF) for separate windows created by the add-in. The code is written in C# except the code which lays out components in windows which is specified in Extensible Application Markup Language (XAML). The OneNote API is used to handle data exchange between the add-in and the core application. This API includes many functions for extracting and adding data to both individual pages and the notebook hierarchy as well as some window adjustments. However, the Microsoft Windows API, also known as User32.dll, is used for most window manipulation tasks.

The add-in is broken into sections which handle various groups of actions. These groups include the Connect class which handles the interactions and OneNote API calls, the Navigation class which controls the additional navigation controls, and the Importer class which handles importing books from other formats into OneNote.

Conclusions

By utilizing the power of OneNote and Tablet PCs, the e-textbook add-in will provide a system which enhances studying, note-taking, and learning by improving on traditional paper and ink solutions. The add-in addresses many problems which have been identified in previous research into note-taking and electronic reader development while leaving opportunities for improvement via internal and external development. Our next step in the project will be to perform a formal evaluation of the tool in a typical engineering learning environment.

1. J. Steimle, I. Gurevych, and M. Mühlhäuser (2007). Notetaking in University Courses and its Implications for eLearning Systems. *DeLFI 2007 5 eLearning Fachtagung Informatik*, 45-56. (Available at http://www.tk.informatik.tu-darmstadt.de/fileadmin/user_upload/Group_UKP/publikationen/2007/delfi2007.pdf, date last accessed 3/15/2012)

2. Microsoft Interactive Classroom (2011). Downloaded on 1/6/2012 from http://www.educationlabs.com/Projects/ic/Pages/default.aspx

3. DyKnow (2011). Downloaded on 1/6/2012 from www.dyknow.com

4. Classroom Presenter 3 (2008). Downloaded on 1/13/2012 from classroompresnter.cs.washington.edu

5. K.A. Kiewra, S.L. Benton, The Relationship Between Information-Processing Ability and Notetaking, *Contemporary Educational Psychology*, Volume 13, Issue 1, January 1988, 33-44.

6. K. Kim,, S. Turner,, & M. Pérez-Quiñones, (2009). Requirements for electronic note taking systems: A field study of note taking in university classrooms. *Education & Information Technologies*, 14(3), 255-283.

7. A. Martinez. (2010, May 23). Amazon.com's Kindle fails first college test. *The Seattle Times*. Downloaded on 1/7/2011 from http://www.seattletimes.com.

8. T. Marmarelli (2010). The Reed College Kindle Study. Downloaded on 1/6/2012 from https://reed.edu/cis/about/kindle_pilot/Reed_Kindle_report.pdf.

9. J. Tront (2010). Operations Needed in e-Textbooks of the Future. Downloaded on 2/21/2011 from http://filebox.ece.vt.edu/~jgtront/wipte/e_textbook_functionality.pdf