



THE DEVELOPMENT OF AN EBook WITH DYNAMIC CONTENT FOR THE INTRODUCTION OF ALGORITHMS and PROGRAMMING

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Abstract

It is very important that the content of Algorithms and Programming course is understood by Computer Engineering students. The eBook designed in this study provides a better explanation of the flow diagrams and programming logic of the algorithms used in the introduction to programming, as well as the abstract processing steps in the computer memory and CPU during programming are animated and visualized by means of computer animations and simulations. The EPUB 3.0 based training content, developed by using animation and interactive content, is expected to create new opportunities for students at anytime and anywhere access. This work also includes the development process of an EPUB 3.0 based eBook for use on computers or mobile devices.

Keywords: EBook, EPUB3.0, Programming Languages

ALGORİTMALAR VE PROGRAMLAMAYA GİRİŞ İÇİN DİNAMİK İÇERİKLİ BİR E-KİTABIN GELİŞTİRİLMESİ

Özet

Algoritmalar ve Programlama ders içeriğinin Bilgisayar Mühendisliği öğrencileri tarafından anlaşılması oldukça önemlidir. Bu çalışmada tasarlanan e-kitap ile Programlamaya Giriş dersinde kullanılan algoritmaların akış diyagramlarının ve programlama mantığının daha iyi açıklanabilmesi ve ayrıca programlama sırasında bilgisayar belleğinde ve CPU'da gerçekleşen soyut işlem basamaklarının bilgisayar animasyonları ve benzetimleri yardımıyla canlandırılması ve görsel hale getirilmesi sağlanmıştır. Animasyon ve etkileşimli içerik kullanılarak geliştirilen EPUB 3.0 tabanlı eğitim içeriğinin her an her yerden erişim sağlanması açısından öğrenciler için yeni fırsatlar yaratması beklenmektedir. Bu çalışma ayrıca, bilgisayar ya da mobil cihazlar üzerinde kullanıma yönelik olarak hazırlanacak EPUB 3.0 tabanlı bir e-kitabın geliştirilmesi sürecine de yer vermektedir.

Anahtar Kelimeler: E-kitap, EPUB3.0, Programlama Dilleri

1 Introduction

In 21st century, "Digital self-learning technology" has become one of the most popular topics. As knowledge increases as a result of the science and technological developments, on the other hand, internet usage rate and the number of mobile device (tablets, smart phones and etc.) users are increasing to access this knowledge. Thus, the reading habits of peoples are changing, and a new reading form based on digital accessibility has emerged instead of printed media such as traditional books, newspapers and magazines [1]. This new reading form is commonly called eBook (electronic book). While eBooks initially contained only text, new generation rich content eBooks supported by interactive materials such as sound, image, graphic, animation or simulation have also started to be published as a consequence of the development in digital publishing [2].

An eBook can be published in many different formats such as HTML, iBooks, Acrobat adobe, Microsoft Word and so on [3]. However, there are two important handicap of having so many forms; these formats are not compatible with each other, and adaptation problems can occur on high resolution screens [4].

As an international standard eBook format, EPUB (Electronic PUBLication) was introduced by IDPF (International Digital Publishing Forum) [5]. It specify a means of encoding, packaging and representing which are structured and

semantically enhanced Web content including XHTML, CSS, SVG, images and other resources for distribution in a single-file format. Then, In October 2011, IDPF presented EPUB 3.0 as a final Recommended Specification. EPUB 3.0 allows complex page layout, and supports different formats of rich media interactivity and new features such as MathML [6].

The development of eBook standards and the widespread adoption of eBook readers are pushing the reuse of various functions of the book in education [7]. In this context, many academic institutions that keep up with technology publish their course content electronically and remotely accessible [2]. Studies [8-10] have also shown that there is a trend toward eBook preference when interactivity is used, and students see the eBook as a productive learning material. Moreover, when appropriate media designs are made and technical problems are avoided, eBooks are seen as candidates for efficient results as part of today's learning-teaching process [11].

In this study, we developed an eBook to Algorithms and Programming course in order to enhance computer engineering students' algorithm ability. It provides a better explanation of the flow diagrams and the basis of programming languages. In the eBook content, abstract operations in the computer memory and CPU during programming are animated and visualized by using of HTML5 and JavaScript animations and simulations. In the next parts of the paper, we mention the

development procedure of this eBook, and we introduce our eBook of Algorithms and Programming Languages.

2 eBook Standards

EBooks have many standards, but mobile devices or eBook readers cannot use all of these types precisely because of adaptation problems. Therefore, to access a wide audience, some of the most frequently used formats (Adobe PDF, EPUB and iBook) need to be selected during the development of eBooks.

2.1 PDF

According to Adobe's definition, "Portable Document Format (PDF) is a file format used to present and exchange documents reliably, independent of software, hardware, or operating system". It can contain links and buttons, form fields, audio, video, images, notes and bookmarks [12]. PDF is one of the most used formats to compose an eBook because it can run smoothly on many computers with free Adobe Acrobat Reader. And it realizes this operation on any devices without destroying the original quality. However, this feature brings a great obstacle for mobile devices. If the content of a PDF file cannot be seen due to character size or the failure to comply with screen, the page size must be adjusted by increasing or decreasing with zoom properties [4].

2.2 iBook

iBook is another eBook format introduced by Apple. iBook standard is similar to EPUB specification, but it differs from the EPUB standard specification in that it is CSS3 tags and proprietary [4]. A great way to create and design interactive Multi-Touch iBooks is to use the iBooks Author tool which is a free application for iPad and Mac. It makes the eBook preparing process very easy with Apple-designed templates that include a choice of page layouts. Moreover, Multi-Touch widgets help enrich the content for an eBook reader. They bring eBook reader swipe-friendly photo galleries, animations that burst off the page, scrolling sidebars to linger over, Pop-Over widgets for an element of surprise, and engrossing 3D objects that are entertaining and interactive [13].

2.3 EPUB & EPUB3.0

EPUB introduced by IDPF is an international eBook format based on explicit specifications written in XML and XHTML. The EPUB format is supported by many different devices and platforms such as Android devices, iPhone, iPad, iPod, MobiPocket, Stanza, Adobe Digital Editions, Sony Reader, Nook, FBReader and many others [4]. It specifies a means of encoding, packaging and representing which are structured and semantically enhanced Web content including XHTML, CSS, SVG, images and other resources for distribution in a single file just like a .zip file. The physical structure of an eBook is shown in Figure 1. An EPUB file consists of two folders (META-INF and OEBPS) and one file (minetype) [6].

- META-INF file includes a file called container.xml. It provides the location of the content.opf.
- The OEBPS (Open eBook Publication Structure) folder includes;
 - Text folder consists of XHTML files that are the content of the EPUB eBook. Each XHTML file is a single section of the eBook.
 - Image Folder consists of cover picture, inserts pictures and so on.
 - Styles Folder includes a main.css and other CSS style sheet files that are used for formatting and styling the XHTML pages.
 - Video Folder consists of video files.

- Misc Folder includes JavaScript files used for adding JavaScript applications on XHTML pages.
 - Font Folder includes a set of font files to control over the appearance of the text with CSS3 or CSS2 font-face rule.
 - Content.opf file contains important information such as the EPUB's metadata (author name, published date, language, eBook ID and the path information of resource file), manifest (a list of every item in the EPUB file), and the spine (the order in which items are viewed as the reader scrolls through the EPUB).
 - toc.ncx file uses "nav" element as the identifier to build a navigational table of contents.
- Minetype file: It identifies packaged form. So, operating system of the reader will know how the eBook is formatted.

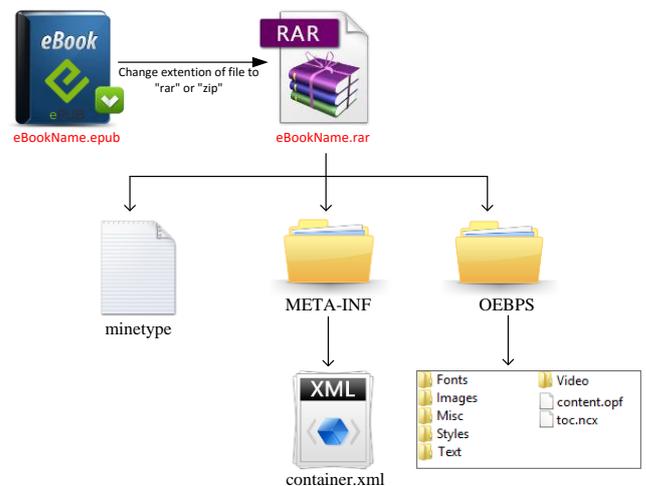


Figure-1. Physical structure of an eBook based on EPUB

EPUB 3.0 is the third major release of EPUB standard. EPUB 3.0 allows the use of the latest Web technologies such as HTML5 and CSS3 to create interactive contents with sounds, videos and animations. Moreover, it supports MathML which is the standard of the equation [5].

EPUB 3.0 consists of a set of four specifications, each defining an important component of an overall EPUB Publication: It defines publication-level semantics and overarching conformance requirements for EPUB Publications [14].

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- EPUB Content Documents 3.0, which defines profiles of XHTML, SVG and CSS for use in the context of EPUB Publications.
- EPUB Open Container Format (OCF) 3.0, which defines a file format and processing model for encapsulating a set of related resources into a single-file (ZIP) EPUB Container.
- EPUB Media Overlays 3.0, which defines a format and a processing model for synchronization of text and audio.

3 An eBook Design for Algorithm and Programming Course

In this study, an interactive eBook of the Algorithms and Programming course which is important to teach the basic principles of computer programming in the field of Computer Science has been realized by utilizing animations, simulations and visual materials. With this eBook, we aimed that students learn the flow diagrams, control structures, methods, and arrays and so on.

In content editing of the eBook, we used a hypertext approach to link coordinating content appropriately, and used font faces and sizes to provide selected readability. We have also seen in this work that it is very important to determine which method to use in EPUB production process. The method affects to production cost, duration and quality of the eBook. Furthermore, it even depends on whether a designer who will make the production should be an expert.

There are many editor for creating an eBook such as Adobe Indesign, Apple Pages, Calibre and Sigil. We used Sigil editor in this work. Sigil is a free, open source, multi-platform eBook editor. It is designed to edit books in EPUB format (EPUB 2 or EPUB 3). The book view of Sigil editor at the development phase of an eBook page can be seen in Figure-2. SIGIL can provides multiple views of the work: book, code and a split mode.

3.1 Course Content

The aim of the course is to teach students how to design an algorithm, and how to analyze a problem, as well as to teach them basic knowledge of structured programming. This course deals with various problems and presents some algorithms and flow diagrams that enable these problems to be realized in practice. For this reason, we surveyed the literature related to Algorithm and Programming course, and examined the interactive approaches on online web sources. In this way we organized our eBook as 9 sections; Introduction to computer programming, Algorithms and Flow Diagrams, C Programming Language, Data types and Operators, Standard C Library, Control Structures and Logical Operators, Loops, Functions and Arrays. Figure-3 shows a designed page about static variables on an eBook reader in vertical position, and Figure-4 show another pages about Compiler Errors in horizontal position.



Figure-3 A designed page on eBook Reader (Vertical)

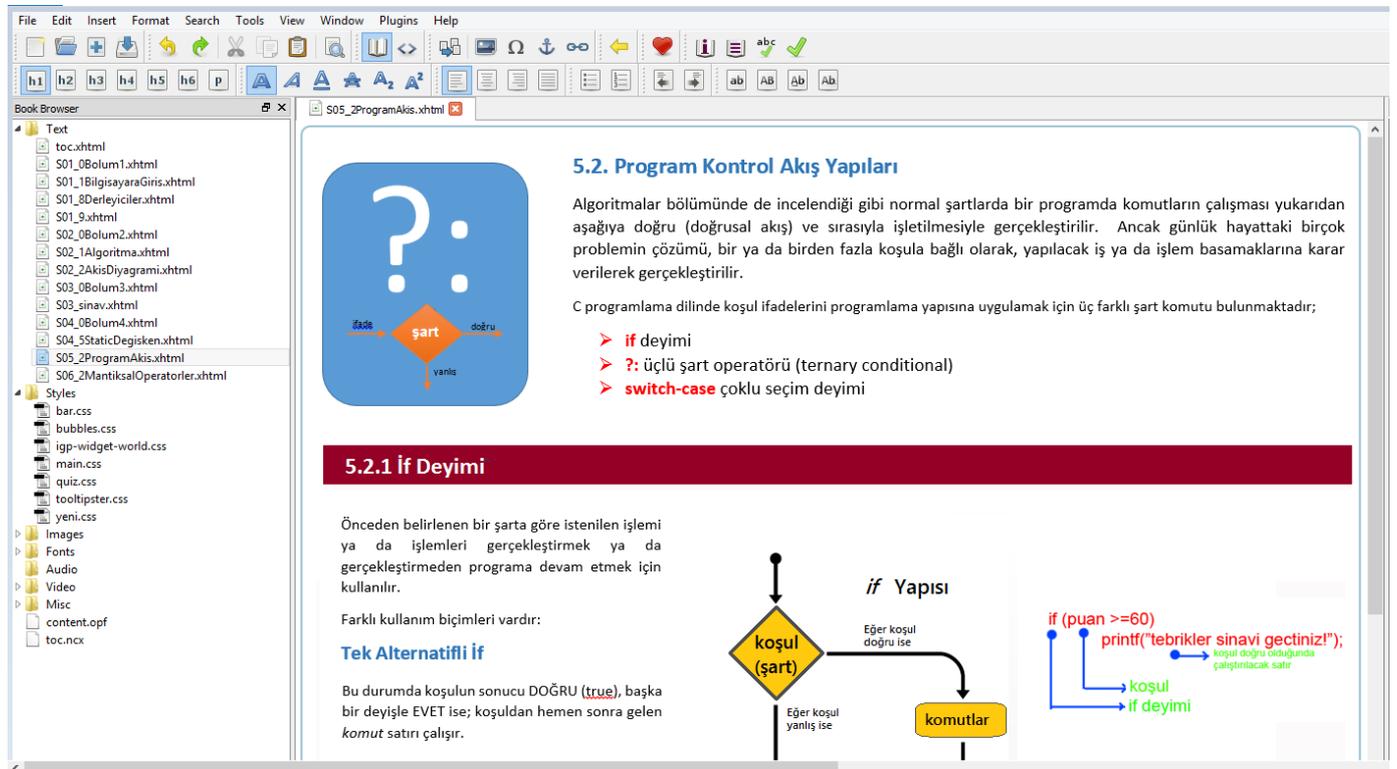


Figure-2 Book view of Sigil editor

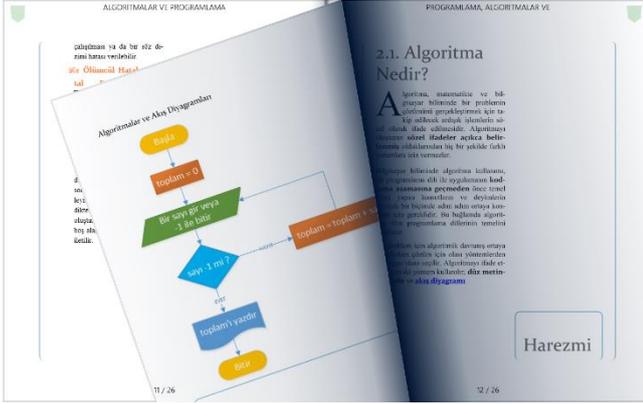


Figure-4 A designed page on eBook Reader (Horizontal)

3.2 Interactive Elements and Content Effects

The use of simulations and animations on learning platforms increases the learning efficiency as well as the ability of the students to put the theories into practice. The difficulties of embodying and envisioning of abstract events that are desired to be taught to the students can be abolished through animations and simulations. To support this approach, we embedded educational interactive elements in our eBook. These interactive elements provide a clearly illustrate the flow diagrams and algorithm design used at the introduction to programming, as well as the abstract processing steps in the computer memory and CPU during programming with. A sample animation of a flow diagram which uses the if-else structure is shown in Figure 5.

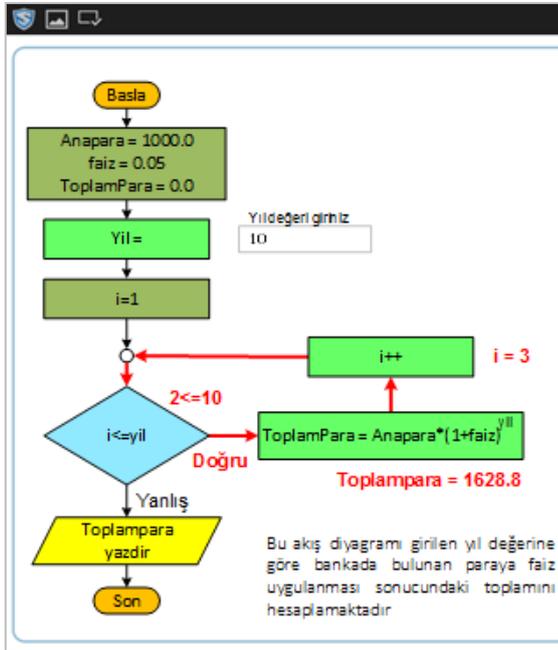


Figure-5 a sample of animation about flow diagrams

The interactive content in the developed eBook to be supported by different media and can work with different formats because we coded these elements with HTML5 and JavaScript based on jQuery library.

In addition to these interactive elements, content effects such as horizontal sliding image panels, horizontal or vertical tutorial panels, pop-up texts and reveal panels were prepared inside the pages in order to ensure that the students does not lose their interest during the presentation of the course content prepared in the eBook. A pop-up window application

used to inform the reader about flow diagrams is given in Figure-6. Also, Figure-7 and Figure-8 show that a sliding image panel application prepared to see the output of the C code.



Figure-6 Pop-up application in a page

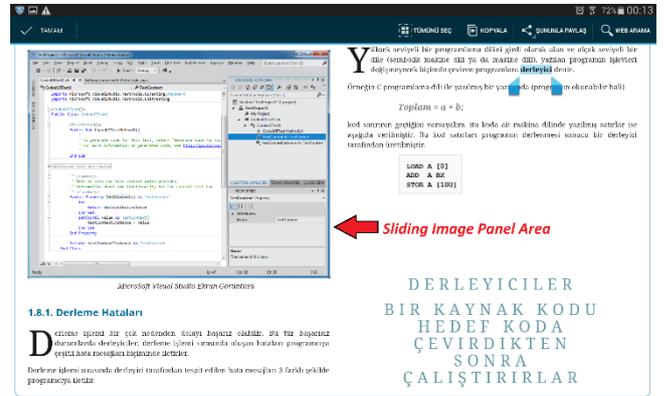


Figure-7 Sliding image panel application image-1

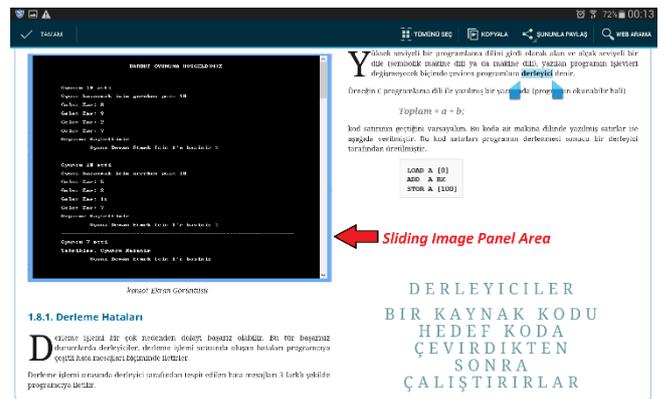


Figure-8 Sliding image panel application image-2

3.2 Interactive Chapter Break Tests

Each section of the eBook includes ten interactive chapter break tests that are consist of true-false, multiple-choice, multiple-response, association, sequence, text-match and sort word exercises. These questions test the students' understanding of the material. Figure-9 shows samples of a true-false question type that we use at the end of chapters.



Figure-9 True – False questions

We did not intend to calculate the total score of student in chapter break tests. Only the right answer is displayed, after the options of the question is checked. Another example of multiple-choice questions is shown in Figure-10.

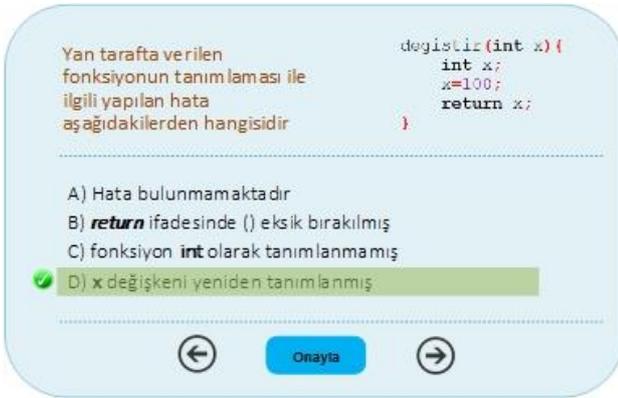


Figure-10 Multiple-choice questions

4 Conclusion

The study achieve a design of an eBook based on EPUB 3.0 with interactive elements for the Introduction to Algorithm and Programming course. The most important feature of EPUB 3.0 is that it is supported by many different devices and platforms. EPUB 3.0 is ability to integrate images, videos, animations, simulations and various widgets coding with HTML5 and JavaScript. While the animations and simulations allow a clearly visualizes the flow diagrams and algorithm design, on the other hand, widgets and other content effects ensure that the students does not lose theirs interest in the eBook.

As new digital reading formats emerge, it is inevitable that people's reading habits will change as well. Therefore, the number of researches on the design and use of eBooks are also on the rise. We also plan to conduct a survey on the usability of our eBook among our students in our future research.

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