Inbooki: Context-Aware Adaptive E-Books

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Abstract. Traditional e-books are more and more exploited by readers, thanks to the chance of reading them on different devices and to the capability of storing a whole library of books in a light and portable device. However, they are still very rigid and do not adapt to the context of the readers. In this paper we propose a system for writing and reading enhanced e-books that are able to *adapt* to the context where they are read and to the user's choices during the reading. Our approach take advantage of the possibilities offered by today's devices, like context-awareness and user interaction. Past proposals are limited to a specific field or did not consider a wide range of external conditions and interactions, providing a very limited adaptation.

Keywords: Context-dependency · E-book

1 Introduction

E-books can be considered as both an evolution of classic paper books and a revolution in the way contents are delivered and read [6]; they are becoming part of our life. Although e-books cannot completely replace conventional books [7] in a very near future, and their spread must face some challenges [9,13], the trend seems to be unfolding in this direction [5,12].

Today's e-books have several *advantages* over conventional books; for example: they can be read using different devices and technologies, letting people choose the preferred one; their visualization can be adapted to the devices' features or to readers' necessities; a single device can store a great number of books, relieving people from the need of carrying heavy books (or a heavy set of books).

Nevertheless, available e-books mainly consist of an electronic version of their paper edition. In our opinion, this leads to a main drawback: they do not take advantage of the possibilities offered by today's devices, such as the information received from *sensors* (light, temperature, orientation, position, etc.), from external *services* (weather, near places, news of the day, etc.), or from the *user's profile and history* (age, sex, previous readings, etc.). As a consequence, today's e-books cannot adapt their content to the context in which they are read, or to the specific user who is reading them.

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The contribution of this paper lies in proposing a system to develop and read *adaptive* e-books. Our concept of adaptive e-book is realized by means of *context-awareness* that is provided to the e-book. Differently from previous approaches, the proposed one aims at being more general and at considering many sources of information. The proposed system, Inbooki, enables writers to structure their book taking into consideration different aspects of the context where readers will actually read the e-book. The produced e-books are called *immersive*-books (shortly *in-books*), suggesting that the readers are "immersed" *in* the context where they read the e-books.

2 Related Work

According to [2], existing systems related to our work can be classified as:

- Location-aware systems, which exploit only a part of the context;
- Context-aware systems, which fully exploit all the context information;
- Context-aware frameworks, which provide an abstract framework for specific context-aware applications.

As said, there are some systems that exploit information about the location (location-awareness) to display customized information to users [3,8,11]. Examples of location-aware systems are e-guides for tourists, as the Cyberguide project [1], which aims at building a mobile context-aware tour guide. The implemented system considered several context parameters to adapt the tour to the reader in a form similar to an e-book. However, this project is mostly focused on geographic information related to the tour, and it cannot be exploited for a general-purpose context-dependent book content.

A few examples of context-aware system are reported in the literature. For instance, Muñoz et al. [10] propose a context-aware system for hospitals that take into consideration several context parameters (not only the user's location) such as patient turnaround time, the location of other users, devices or artifacts, and the user's role. This is an interesting approach but strictly oriented to a specific field.

To summarize, the approaches we can find in the literature suffer of being very bound to a specific field or of exploiting little context information. Our aim is to propose a more general approach that considers a wider range of information available.

3 In-Books

3.1 Context Model

The context of the reading is modeled around three sets of parameters: *environment* parameters, *profile* parameters, *reading* parameters.

Environment parameters are the set of external conditions surrounding the user while reading an in-book. Currently, the in-book structure supports GPS

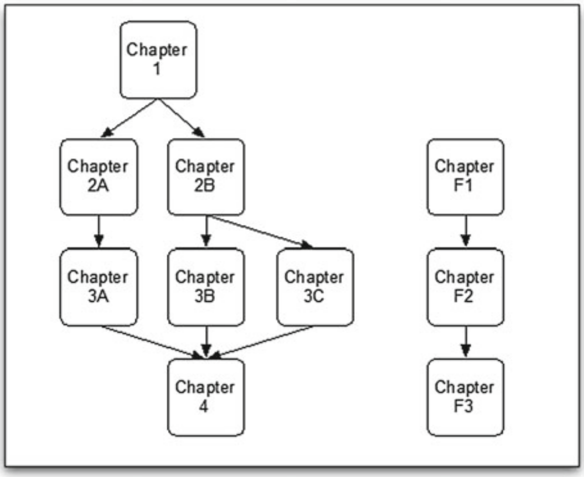


Fig. 1. Example of in-book graphs

localization, weather, air temperature, season and time of the day. Weather and air temperature are determined using third-party web services and GPS location. *Profile* parameters contain the essential data about the user's profile: gender and age. The user sets these parameters during the registration process, and they can be modified in the reader apps. *Reading* parameters contain the "history" of the user's reading process for a given in-book: chapters read, reading conditions' status while reading each chapter, progress.

All these context parameters are used by the Inbooki mobile app[1] to determine which content to show the reader, as explained in the following.

3.2 In-Book's Structure

An *in-book* is an e-book composed of one or more graphs of chapters. Figure 1 reports examples of an in-book graph. Each chapter can have one or more parents and one or more children, and it is composed of an ordered series of blocks. Each block has a specific type ("title", "text", "image") and it can count on one or more variations, depending on the reading conditions. Variations can be grouped in 2 sets: *narrative* and *descriptive.*

Since an in-book is a graph, each chapter can have more than one child: narrative variations occur when the user completes the reading of a chapter and the Inbooki mobile app determines (using the user's reading conditions) which child chapter to show next among the possibilities. If the reading conditions meet the requirements of more than one chapter, a choice is presented to the user (a *fork*). If there is only one child chapter and its display conditions are not met, the user is forced to wait (or to take action) until they are met (e.g. the user can be

[1] This is the app to read in-books, see 4.4.

required to go to a specific location, or he can be forced to wait until a specific time of the day comes). Descriptive variations occur inside a chapter's block. Each block can have one or more variations, each one of them having different display conditions. When the reader app has to render a chapter's text, it parses its whole content and determines which descriptive variations have their display conditions satisfied by the current user's reading conditions; if, for a given block, no variation has its display conditions met by the reading conditions, the whole block is not rendered.

3.3 Next Chapter Selection

When the user starts reading an in-book or finishes reading a previous chapter, the reader apps must determine how to continue the in-book rendering. The first step is to count how many children chapters have their visibility conditions fully satisfied by the user's reading conditions (environment parameters, profile parameters and reading parameters): if there are one or more results, they will be added to the possible following chapters set; if there are no results, the reader app tries to find the children chapters that have their profile and reading parameters satisfied: if there are one or more results, they are added to the possible following chapters set; if not, a virtual "book-end" chapter is added to the possible following chapters set. At this point the possible following chapters set consists of one or more chapters. A query is made to obtain free chapters that have their reading conditions satisfied, and the results are added to the possible following chapters set. The possible following chapters set is then analysed: if it consists of two or more chapters, a fork is displayed to the user, who can choose which path to follow. At this point, only one chapter is chosen for rendering. If it is a virtual "book-end" chapter, the book ends. If it is a real chapter, this is further analysed to determine whether its reading conditions are fully satisfied or not: if one or more parameters are not met yet, a "waiting screen" is shown to the user, who will have to wait in order to continue until the reading conditions are met; if the reading conditions are met, the chapter is rendered.

4 Inbooki's Architecture

The architecture powering Inbooki is composed of four subsystems, sketched in the following subsections but not detailed due to space limitation.

4.1 The Inbooki Platform

The platform is the *core* subsystem of Inbooki, providing a substrate which is used by the other subsystems to interact using a private API framework. There are two main API components: *AccountAPI*, which provides access to account utilities such as user registration, login, purchased books listing, account management, etc.; and *MarketAPI*, which provides an interface to the marketplace, including functions like in-book download, in-books information retrieval, marketplace search, etc. API security is ensured by a proprietary OAuth 2.0 implementation, written in PHP.

4.2 The Web Interface

This subsystem comprises a web interface to the marketplace and to account registration and management utilities. The main endpoint for the web interface is the Inbooki website (http://www.inbooki.com), which was developed using HTML, PHP and Javascript using a Bootstrap template.

4.3 The Inbooki Editor

The Inbooki Editor plays an important role in the Inbooki architecture: it provides the authors with a user-friendly web application that allows them to write in-books in an easy-to-use yet complete environment. Using the editor, the authors can add *immersive* and *interactive* features to their in-books using a graphic interface. A built-in compiler gives the authors the possibility of creating deployable in-books that can be read on mobile devices running the Inbooki app for iOS or Android.

Using the editor authors can submit their in-books to the marketplace. The editor is written in PHP, HTML and Javascript, using additional libraries as jQuery to enhance the user experience.

Snapshots of the web interface will be shown in Sect. 5.

4.4 Mobile Apps for iOS and Android Devices

An in-book contains several immersive and interactive features that are not supported by current e-books standards like ePub, mobi, etc. This is the reason why conventional e-book readers cannot display an in-book. iOS and Android Inbooki apps fill this gap, providing a reading experience that is extremely similar to the one provided by classic e-book readers (e.g. the user swipes to go to the next page), while introducing immersive and interactive features that allow the readers to fully enjoy the possibilities offered by the in-books.

The Inbooki apps give the reader the possibility of downloading the available in-books and automatically syncing the reading progress on all their devices (e.g. a given reader can use the same Inbooki account on an iPhone and on an Android device).

The immersive variations to the in-book's text–such as variations determined by weather conditions, time of the day, day of the year, user profile, etc.–are automatically processed during the reading, and each chapter is compiled on the fly using the conditions set by the author and determined by the reader's environment: the story itself, or single paragraphs, can thus change according to these conditions.

The Inbooki apps rely mainly on GPS localization to detect the reader's environment and to define the context: the data received is used to interact with external services to retrieve weather conditions and temperature, as well as to determine the "visibility" of geolocation-conditioned chapters (chapters that can be read only if the reader is within a certain distance from a specific geographical point).

The user's reading "history" is recorded and can be used by the authors while writing the in-book to determine story variations according to the path followed by each reader: for example, the story can change according to the path the reader chose in earlier chapters.

In-books also present interactive features: the author can design *forks* along the story where the reader is actually asked to make a decision. When the reader encounters a fork, the mobile app shows them the list of possible decisions and then calculates the following chapter according to this choice.

5 Example of Use and Impact

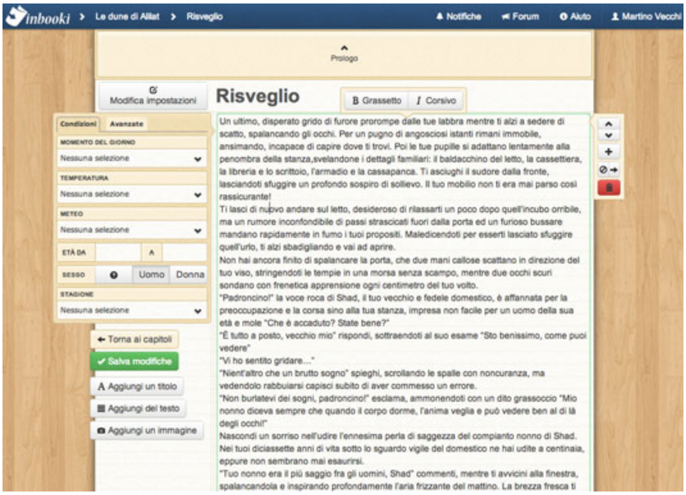
In this section we show how the Inbooki system can be exploited to write and to read in-books. We provide also an overview of possible applications.

5.1 Developing an In-Book

To develop an in-book, the writer must first fill in the text of the chapters (see Fig. 2) as in a traditional editor.

The chapters have a customizable display order in the editor (see Fig. 3 left) which doesn't necessarily correspond to the narrative order that is seen by the readers. For instance, the chapter "Scegli di confidarti" is a sibling of "Rispondi che non te lo ricordi": they both follow "Colazione in famiglia" (the reader is shown one of them depending on his context), but they continue in different narrative threads.

This leads to a non-linear chapters graph (see Fig. 3 right); using the editor the writer can keep under control the structure of the in-book.

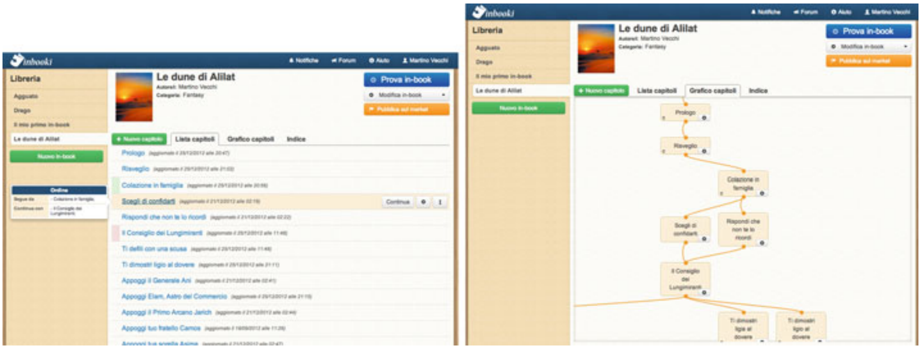


MOMENTO DEL GIORNO: Nessuna selezione
TEMPERATURA: Nessuna selezione
METEO: Nessuna selezione
ETÀ DA A
SESSO ● Uomo Donna
STAGIONE: Nessuna selezione

Risveglio

Un ultimo, disperato grido di furore prorompe dalle tue labbra mentre ti alzi a sedere di scatto, spalancando gli occhi. Per un pugno di angosciosi istanti rimani immobile, ansimando, incapace di capire dove ti trovi. Poi le tue pupille si adattano lentamente alla penombra della stanza,svelandone i dettagli familiari: il baldacchino del letto, la cassettiera, la libreria e lo scrittoio, l'armadio e la cassapanca. Ti asciughi il sudore dalla fronte, lasciandoti sfuggire un profondo sospiro di sollievo. Il tuo mobilio non ti era mai parso così rassicurante!
Ti lasci di nuovo andare sul letto, desideroso di rilassarti un poco dopo quell'incubo orribile, ma un rumore inconfondibile di passi strascicati fuori dalla porta ed un furioso bussare mandano rapidamente in fumo i tuoi propositi. Maledicendoti per esserti lasciato sfuggire quell'urlo, ti alzi sbadigliando e vai ad aprire.
Non hai ancora finito di spalancare la porta, che due mani callose scattano in direzione del tuo viso, stringendoti le tempie in una morsa senza scampo, mentre due occhi scuri sondano con frenetica apprensione ogni centimetro del tuo volto.
"Padroncino!" la voce roca di Shad, il tuo vecchio e fedele domestico, è affannata per la preoccupazione e la corsa sino alla tua stanza, impresa non facile per un uomo della sua età e mole "Che è accaduto? State bene?"
"È tutto a posto, vecchio mio" rispondi, sottraendoti al suo esame "Sto benissimo, come puoi vedere"
"Vi ho sentito gridare..."
"Nient'altro che un brutto sogno" spieghi, scrollando le spalle con noncuranza, ma vedendolo rabbuiarsi capisci subito di aver commesso un errore.
"Non burlatevi dei sogni, padroncino!" esclama, ammonendoti con un dito grassoccio "Mio nonno diceva sempre che quando il corpo dorme, l'anima veglia e può vedere ben al di là degli occhi!"
Nascondi un sorriso nell'udire l'ennesima perla di saggezza del compianto nonno di Shad. Nei tuoi diciassette anni di vita sotto lo sguardo vigile del domestico ne hai udite a centinaia, eppure non sembrano mai esaurirsi.
"Tuo nonno era il più saggio fra gli uomini, Shad" commenti, mentre ti avvicini alla finestra, spalancandola e inspirando profondamente l'aria frizzante del mattino. La brezza fresca ti

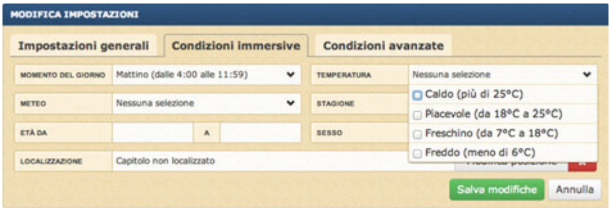
Fig. 2. Inbooki chapter text



Segue da – Colazione in famiglia
Continua con – Il Consiglio dei Lungimiranti

Prologo (aggiornato il 25/12/2012 alle 20:47)
Risveglio (aggiornato il 25/12/2012 alle 21:03)
Colazione in famiglia (aggiornato il 25/12/2012 alle 20:56)
Scegli di confidarti (aggiornato il 21/12/2012 alle 02:19)
Rispondi che non te lo ricordi (aggiornato il 21/12/2012 alle 02:22)
Il Consiglio dei Lungimiranti (aggiornato il 25/12/2012 alle 11:46)
Ti defili con una scusa (aggiornato il 25/12/2012 alle 11:46)
Ti dimostri ligio al dovere (aggiornato il 25/12/2012 alle 21:11)
Appoggi il Generale Ani (aggiornato il 21/12/2012 alle 02:41)
Appoggi Elam, Astro del Commercio (aggiornato il 25/12/2012 alle 21:15)
Appoggi il Primo Arcano Jarich (aggiornato il 21/12/2012 alle 02:44)
Appoggi tuo fratello Camos (aggiornato il 18/09/2012 alle 11:26)
Appoggi tua sorella Asima (aggiornato il 21/12/2012 alle 02:47)

Fig. 3. Inbooki chapters (left) and graph (right)



MOMENTO DEL GIORNO	Mattino (dalle 4:00 alle 11:59)	TEMPERATURA	Nessuna selezione
METEO	Nessuna selezione	STAGIONE	□ Caldo (più di 25°C) □ Piacevole (da 18°C a 25°C)
ETÀ DA	A	SESSO	□ Freschino (da 7°C a 18°C) □ Freddo (meno di 6°C)
LOCALIZZAZIONE	Capitolo non localizzato		

Fig. 4. Inbooki chapter conditions

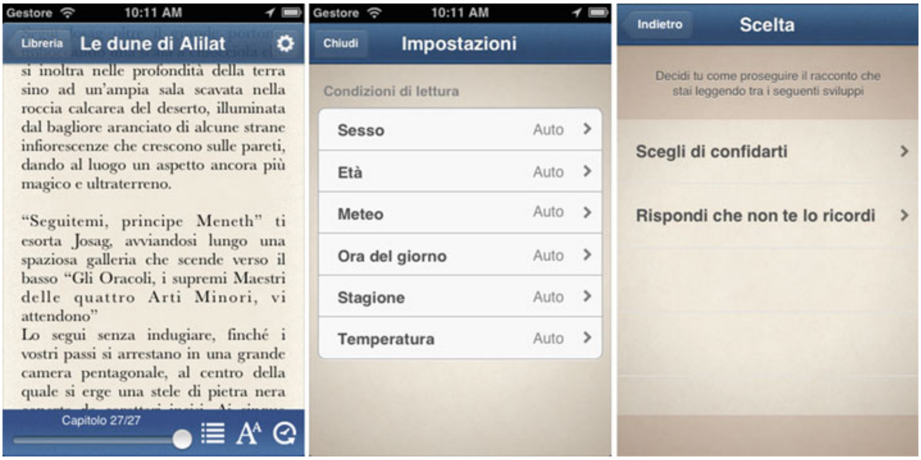
Furthermore, different conditions can be associated to each chapter. Figure 4 shows a dialog in which the following conditions can be defined: time of the day; weather conditions; age of the reader; external temperature; season; gender of the reader; location. Advanced conditions can be specified as well.

Inbooki has the capability of setting geolocalization conditions for a chapter: the writer can decide where in the world a given chapter can be read or, form the point of view of chapters, which ones will be triggered by a reader's given location.

5.2 Enjoying an In-Book on Devices

We are aware that it is impossible to provide readers with the true experience of an in-book, since it is very dynamic, anyway in this section we sketch how the readers can enjoy the in-book using a mobile device (in this case, an Apple iPhone). As it can be seen from Fig. 5 left, the reading of in-books is very similar to the reading of standard e-books.

One of the specific enhancements offered by in-books is the possibility to set some parameters before starting the reading; Fig. 5 center reports the reader's choice of gender, age, weather conditions, hour of the day, season, and temperature. The values of all these parameters can be defined in an automatic way: they can be retrieved from sensors, from (web) services, or from the user's profile.



si inoltra nelle profondità della terra sino ad un'ampia sala scavata nella roccia calcarea del deserto, illuminata dal bagliore aranciato di alcune strane infiorescenze che crescono sulle pareti, dando al luogo un aspetto ancora più magico e ultraterreno.

"Seguitemi, principe Meneth" ti esorta Josag, avviandosi lungo una spaziosa galleria che scende verso il basso "Gli Oracoli, i supremi Maestri delle quattro Arti Minori, vi attendono"
Lo segui senza indugiare, finché i vostri passi si arrestano in una grande camera pentagonale, al centro della quale si erge una stele di pietra nera

Condizioni di lettura

Sesso Auto ›
Età Auto ›
Meteo Auto ›
Ora del giorno Auto ›
Stagione Auto ›
Temperatura Auto ›

Decidi tu come proseguire il racconto che stai leggendo tra i seguenti sviluppi

Scegli di confidarti ›

Rispondi che non te lo ricordi ›

Fig. 5. App interface: reading interface with menu (left), user's profile (center), Reader's choice (right)

In Fig. 5 right we show a distinctive feature of in-books: facing a fork, the reader can choose which path to follow, which will lead to two different chapters, according to the structure of the in-book as defined by the writer.

5.3 Possible Applications

From a literary point of view, Inbooki introduces a new kind of e-book, in which stories can unfold in different directions depending on the user's choices and environment. An in-book could be seen as an enhanced version of the old game-books, quite popular in the '80s. Using the Inbooki Editor, the creation of an interactive and immersive e-book does not require any technical skills, and this represents an opportunity for authors to express their creativity without resorting to software developers to create their interactive e-books.

A practical example of use of Inbooki is found in the *guidebooks* field: currently, the creation of an interactive guidebook, able to use the reader's location to provide enhanced information, is restricted to who is willing and able to contract a software house and develop a dedicated mobile app. This means having to cope with the difficulties of deploying and distributing an app among different platforms (iOS, Android), and to depend on the software development team to provide the users with the updated content. Inbooki allows guidebook authors and editors to create their in-books using the Inbooki Editor and distribute them automatically to iOS and Android mobile devices, without needing any technical knowledge. The updating of the in-book content can be done using the Editor, and the release of new versions of the in-book is notified automatically to users, who can download it to their devices. In the guidebooks' field, an in-book can provide immersive and interactive e-books that can suggest to the user different tours and paths depending on the environment (e.g. the weather), on their personal interests (using forks) or their profile (gender and age). Using free chapters, specific content can be displayed depending on the location of the user and the environment conditions.

The concept of in-book can have a big impact on the e-book market, creating a niche for interactive and immersive stories and guidebooks. The supported features of the in-book can be easily further extended, thanks to its open structure which allows different types of blocks to compose a single chapter, and thanks to the flexible format of chapters' conditions. In the future, for example, video support could be introduced, or web-enhanced blocks could be defined to integrate web pages inside chapters.

Outside the literary field, Inbooki can be a useful tool to create simple context-aware applications without the need of any specific technical knowledge. A typical application could be the creation of business scenario tests, where MBA students have to make business decisions based on the information provided in the text. These business scenario tests could be easily developed by teachers using the Inbooki interface, making use of the "fork" features of in-books, or provided directly by authors or publishers.

6 Conclusion and Future Work

In this paper we have presented Inbooki, a system to develop adaptive e-books that take into consideration the context where they are read and which allow user interaction. We have sketched some of their uses, but we believe that many others could be possible.

An important aspect for the spread of e-books in general and *immersive* e-books in particular is the fact that people should be aware not only of the capabilities of this format, but also of the availability of these kinds of books [4]. Currently there are some in-books available, but a lot of advertisement is needed to have a good spread of this kind of formats.

Regarding future work, the system can be further extended to widen the set of sensors and context information that authors can use to define the in-books' behavior. In this direction, we are defining new reading conditions which will be available in the web editor in the next months. Interactivity can be enhanced enabling the readers to directly add content to the in-books, and encouraging the author-reader relationship adding specific communication tools to the Inbooki apps. User experience and usability will be improved by the implementation of specific user testing sessions. Non-alphabetic language support must be enhanced to make in-books available worldwide.

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