

Investigating E-Commerce Systems for Book Sales: From Theoretical Foundations to Software Development

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Abstract

The paper emphasizes the relevance of the development of digital markets and e-commerce software systems in the field of book sales, defines the problems of engineering a modern book sales software system, researches the theoretical foundations of building e-commerce systems and platforms for book sales, analyses architectural solutions for building modern software systems sale of books, and an electronic bookstore was designed using modern technologies.

Keywords

E-commerce, e-bookshop, digital platforms for selling books, e-bookstore architectural solutions

1. Introduction

The demand for books in the digital market is growing for several important reasons, including the constant need for knowledge and information, the importance of scientific and academic literature as a source of authoritative information, which stimulates the demand for books in educational and scientific domains; cultural and emotional significance, technological development and accessibility, the wide availability of books via the global Internet, the growing interest in self-publishing (Amazon Kindle Direct Publishing, Wattpad, etc.), the constant increase in the level of education, the development of new knowledge.

2. Relevance and importance of the study

The book market will continue to develop and remain important and in demand among other digital markets, as it is able to adapt to new conditions and technological changes, to the possibilities of the modern digital world, while at the same time satisfying different consumer needs. A digital market (e-market) is a system of economic relations in the digital space that develops between economic entities in the process of trading services and/or goods through digital and information and communication technologies [1]. They are electronic platforms on the global Internet where buyers and sellers conduct commercial transactions using digital technologies.

There are many organisational and economic models of digital marketplaces, for example, B2C [2], B2B, C2C or P2P, C2B, S2C, etc. Digital marketplaces are becoming prevalent and profitable for key reasons for key reasons, the most important of which are convenience and accessibility, i.e. the ability for customers to shop at any time and from any location, which greatly enhances convenience and global reach, a wide range of products, reduced logistics costs, business process optimisation,

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transparency and trust, transaction security, scalability, mobile technology, environmental benefits and ICT-enabled innovation.

Many digital platforms are using AI to improve recommendations, personalise user experience, and efficiently manage the supply chain for e-commerce consumers.

E-marketplaces also entice consumers and bind them to their platforms through indirect services such as free shipping, video and audio streaming, free books, etc. Some marketplaces offer annual memberships. These intangible benefits attract and ensure greater consumer commitment.

Successful marketplaces offer a wealth of marketing and personalisation opportunities. Many of them use a customer data platform to hyper-personalise the customer experience with sophisticated AI-powered technologies.

Most marketplaces enable one-to-one communication with customers. The ability to use sophisticated analytics to assess the competition and adjust prices, promotions, and offers is invaluable. Using data to promote specific product lines, increase production and optimise operations to meet demand is crucial.

Marketplaces focus on the overall customer experience, including after-sales service.

In a global economy, businesses can go global with the help of marketplaces that have international reach. Digital marketplaces are beneficial for both sellers and buyers due to their potential to save time and money, and provide flexibility and scalability for businesses. Examples of digital marketplaces include platforms such as Amazon, eBay, Etsy, OLX, as well as service marketplaces, such as Upwork or Fiverr.

Digital markets through e-commerce systems allow to enter the global market without the need to open physical outlets, which simplifies access to new markets and expands the audience of potential buyers. Current issues of e-commerce systems development are described in [3].

According to Statista, e-commerce sales will be worth more than USD 6 billion by 2024, up from USD 4.2 billion last year, with marketplaces being the main driver of this digital commerce growth [4]. The global book market was valued at USD 144.67 billion in 2023 and is expected to grow at a CAGR of 1.8% from 2024 to 2030 [5].

It should be noted that the first product sold on Amazon was a book entitled «Fluid Concepts and Creative Analogies: Computer Models of the Fundamental Mechanisms of Thought» by D. Hofstadter [6], which described a platform for selling books over the Internet, since books were then a popular product for e-commerce due to their wide range and relatively easy delivery system.

It is worth noting that e-commerce is an economic activity in the field of electronic purchase and sale, sale of goods remotely to a buyer through electronic transactions using information and communication systems and technologies; electronic economic activity that provides a full cycle of business processes, including ordering goods/services, making payments, delivering goods/services using ICT and ensuring the transfer of property rights of legal entities/individuals to others [1].

Therefore, the topic of research on building a modern e-bookstore remains relevant for many reasons related to the development of technology, changes in consumer behaviour and the transformation of the book industry.

E-retailers, including bookstores, have been gaining popularity due to the convenience of online shopping. Consumers appreciate the ability to buy books instantly from the comfort of their homes.

Demand for e-books continues to grow as they are convenient, easy to store and accessible across a variety of devices, allowing readers to easily purchase and download books without physical limitations. In addition, the popularity of audiobooks is also gaining ground as people can listen to books while driving, exercising or doing other activities, creating new opportunities for e-bookstores to offer multimedia formats of literature.

As mentioned above, e-retailers are actively implementing AI technologies to improve the user experience. Personalised book recommendations based on previous purchases and analysis of reading behaviour help to attract customers and increase sales. The use of big data analytics allows e-bookstores to better understand their customers, predict demand, and optimise their product range. E-bookstores make it possible to buy books from anywhere in the world, which is especially

important for readers who want to have access to books in different languages or on specific subjects that are difficult to find in local stores.

The trend of self-publishing is gaining momentum. Authors from all over the world can publish their books in e-stores such as Amazon Kindle or Google Play Books without the intermediary of major publishers, creating new opportunities for authors and expanding the book market [7].

It is worth noting that people are increasingly choosing e-books and audiobooks as they offer more flexibility and mobility.

And subscription-based services, such as Kindle Unlimited or Scribd, offer unlimited access to digital libraries of books for a fixed fee, making reading even more affordable.

A digital library is an organised collection of digital versions of books, articles, documents, images, videos, audio recordings and other materials available via the Internet or local computer networks, which allows users to access resources without having to physically visit the library [8]. Examples of digital libraries include Google Books, Project Gutenberg, Europeana, etc.

Digital libraries contribute to the dissemination of knowledge, science and culture by making information more widely available.

The COVID-19 pandemic has accelerated the transition to online shopping, and e-bookstores are no exception. With the increase in distance learning and self-directed learning during the pandemic, many people have started buying educational books online.

It is also important that modern e-bookstores can offer interactive books that include videos, images, sound effects, or enable integration with other resources, making the reading experience more enjoyable. E-platforms can create communities of readers based on digital platforms, allowing for the exchange of reviews and recommendations, which increases user engagement. Competition between platforms such as Amazon, Google Play Books, Apple Books and others stimulates the development of new features and improvements in user experience, motivating e-retailers to continually improve their services and adapt to new market demands.

With growing environmental concerns, e-books are a more attractive option for many consumers as they do not require the use of paper and do not need to be transported, reducing the carbon footprint. E-stores continue to promote reading and support literary culture. They allow people to easily access works by classics, contemporary writers and scholarly publications. E-stores make books accessible to different age groups, social groups and regions, which contributes to the growth of the global readership.

Thus, the relevance of the study is that it is necessary to apply innovative approaches to the creation of an e-bookstore to ensure competitiveness and user-friendly approach due to changes in consumer preferences, growing competition in the book market and the need for innovation, globalisation processes and strengthening of international markets.

3. E-commerce software system for e-bookshop

The purpose of this study is the effective sale of books of any genre based on the developed software system of e-commerce for the sale of books taking into account modern information technologies. The aim of the research outlines the following tasks: to investigate the theoretical foundations of building e-commerce systems; to carry out an analysis of architectural solutions of e-commerce systems of book sales, to implement own software system of e-commerce of book sales. The object of research is book sales processes. The subject of the research is the software system of e-commerce of book sales. Research methods of system analysis and synthesis, generalization, and formalization were applied.

Interactive features should be definitely added to allow users to form communities based on their books or author preferences, share recommendations and read reviews, and help individuals select books through interactive tests or surveys. Conducting virtual tours or presentations with book authors through AR technologies is also an interesting marketing ploy if the online bookstore provides such activities.

In the digital era, it is necessary to ensure digital rights for people. Therefore, the use of blockchain technologies to protect copyrights and manage digital book licences is an important trend in the functioning of online bookstores. This is primarily the creation of platforms for selling books with a decentralised approach, where authors can independently put their works up for sale. In terms of innovations in supply chains and delivery methods, it is the improvement of the instant delivery system for e-books, including their integration with other devices (e.g. smart glasses or wearable gadgets). With regard to drone delivery of paper books, if a store also sells paper books, the use of drones to deliver books quickly, especially to hard-to-reach areas, is advisable. Improving the user experience (UX) is particularly important. Adding game elements such as reading achievements or completing tasks to attract more users and adding points (discount systems) will promote certain target audiences, while integrating voice assistants to quickly search and order books will promote users, especially those with special needs. The organisation of virtual book clubs and special chats where participants can discuss books online in real time is already becoming a daily reality.

The study of building bookselling websites involves a wide range of academics, IT and marketing professionals, and e-commerce experts. Much e-commerce research, including online book sales, is conducted at universities. Marketing, IT, and business professionals can study e-commerce models, optimising user experience, and the impact of technology on the book market. As mentioned above, as one of the first and largest online booksellers, Amazon actively conducts research to improve its platforms, analyse consumer habits and optimise sales processes.

Marketing professionals conduct research on how to optimise bookselling websites to increase their efficiency, attractiveness and user experience. Designers focus on creating user-friendly interfaces for book selling sites, researching how to make the user experience more intuitive and enjoyable.

AAP (Association of American Publishers) conducts research and publishes reports on changes in the book market, including e-commerce [9]. McKinsey, Boston Consulting Group, and Deloitte conduct research on market trends, including in the field of e-commerce, including e-bookstores.

S. Kodali in her paper "The design and implementation of an e-commerce site for online book sales" examined the process of developing and implementing an e-commerce site for book sales. It discusses the technologies used to create such a site, including ASP.NET and relational databases (Open Scholarship) [10].

There are many digital book e-commerce platforms that specialise in selling both print and e-books. These platforms offer users a wide selection of books and convenient ways to purchase and read them on various devices. In particular, these are Amazon (Kindle Store), Apple Books, Google Play Books, Barnes & Noble (NOOK), Kobo, Scribd, Book Depository, Audible, LibriVox, etc. Each platform caters to specific needs, whether it's subscription-based models, physical book delivery, or ecosystem integration. Amazon (Kindle Store) offers both e-books and print books, with a focus on e-books and compatible with Kindle devices, Kindle apps (iOS, Android, PC, Mac). Apple Books offers e-books and audiobooks integrated with the Apple ecosystem, exclusive to Apple devices (iPhone, iPad, Mac). Google Play Books proposals e-books and audiobooks available for purchase, android devices, iOS devices, and web browsers. Barnes & Noble (NOOK) offers e-books, print books, and NOOK-branded e-readers, NOOK devices, NOOK app (iOS, Android).

A comparative description of digital platforms for selling books is given in Table 1, enabling an understanding of their features, strengths and weaknesses.

As can be seen from the comparative analysis, Amazon Kindle and Google Play Books have the largest catalogues and global availability. Integration with their own branded devices and support for the latest formats are offered by Apple Books and Kobo. Scribd is distinguished by its subscription model, which makes it attractive to those who read a large number of books.

Competition among e-retailers is fierce today, so an effective e-commerce system for selling books can be a pivotal factor in staying competitive in the book market. Ease of use, conversion rate optimisation on e-commerce sites, the impact of user experience on book sales and analysis of

consumer behaviour in the online reading sphere are key to acquiring and retaining customers for book sales sites.

Table 1

Comparative characteristics of digital platforms for selling books

Platform	Book Types	Sales Models	Features	Target Audience
Amazon (Kindle Store)	Electronic and printed	Direct sales, subscriptions	The largest selection of books, a convenient interface, the possibility of self-publishing through KDP	Wide audience, e-book lovers
Apple Books	Electronic	Direct sales	Integration with Apple devices, beautiful design	Apple users who value design and convenience
Google Play Books	Electronic	Direct sales	Synchronization with a Google account, support for various formats	Android users looking for convenience
Barnes & Noble (NOOK)	Electronic and printed	Direct sales, subscriptions	Specialized NOOK devices, customer support	Lovers of traditional bookstores
Kobo	Electronic	Direct sales	Integration with libraries, support for free books	Different readers
Scribd	Electronic and audio books	Subscription model	Unlimited access to books and audiobooks by subscription	Users who like to read different content
Audible	Audio books	Direct sales, subscriptions	Specialization in audio books, original programs	A broad audience focused on audio content

The rapid development of new technologies, such as mobile applications or large-scale e-commerce software systems, requires constant development and innovative updating of one's own product and its adaptation to the requirements of the book market [16]. With the increasing volume of online transactions, the protection of users' personal data is becoming extremely important, so research into electronic payment systems and security measures is a necessary component of the success of e-commerce software systems. As a result, the research is of both academic and applied significance for the development of effective e-commerce software systems for book sales, in line with current trends and market needs.

4. Designing and programming e-commerce websites

Designing and programming e-commerce websites requires a deep understanding of business and user needs, as well as the application of the latest technologies and international standards to ensure efficiency and security [10-11]. The website [12] offers how to develop a web system for selling books in 10 steps.

The first step in the design process is to define the objectives of the e-commerce store and the needs of the target audience. The navigational structure of the site is determined so that users can easily find the information and products they need.

The design and interface should be developed to be both aesthetically pleasing and functional. Choosing a technology platform is a critical step, where different options such as Magento, Shopify, WooCommerce, etc are considered, taking into account business needs and technical capabilities.

When programming the application, it is important to implement functionality such as a product catalogue system, shopping cart, and checkout options. Integration with payment systems, such as PayPal or Stripe, is important to ensure the convenience and security of payment. Fraud prevention and transaction security require the use of SSL certificates.

Additionally, search engine optimisation (SEO) is necessary to increase the visibility of the site in search results. The use of user feedback and testing is an important step in ensuring that all functions work correctly and that users are satisfied. Feedback is also used to make improvements to the website.

All these stages combine to create an effective and user-friendly e-commerce website that meets the needs of the business and provides satisfaction to the users.

When designing and programming e-commerce websites, it is equally important to consider several key aspects that affect the success of an online business. User experience (UX) is the most important. An intuitive and attractive design, easy navigation, fast page loading and a convenient checkout process are all critical to retaining users. The website should be optimised for different devices, including smartphones and tablets. More and more people are using mobile devices to shop, so it is important that the site looks and works well on all screens. Protecting users' personal information is crucial. Using SSL certificates, securing payments and ensuring the confidentiality of information will help build customer trust.

The site should be optimised for search engines to ensure high visibility in search results, including the use of keywords, meta tags, image optimisation and other techniques to help drive traffic. It is important to ensure that the site has all the necessary features, including convenient product filters, a review system, product comparison, multiple payment methods and proper integration with logistics services.

Implementing analytical tools such as Google Analytics will help track user behaviour on the website, which will allow to improve its functionality and adapt marketing strategies.

When designing and programming e-commerce sites for the sale of books, it is essential to consider a number of specific aspects that can have a significant impact on user experience and business efficiency. Users should be able to easily find the books they are looking for, which can be achieved through a clear category structure, filters by genre, author, and other parameters. Including an autocomplete search function can also make finding books much easier.

It's vital to provide detailed information about books, including descriptions, reviews, ratings, covers and sample text, to help users make purchasing decisions. Feedback from other readers can also add credibility to the product. The ordering process should be as easy as possible. The site should support multiple payment methods and provide the ability to quickly fill out forms to avoid abandoned carts. Enabling cart saving features in case the purchase is not completed can also increase the likelihood of a customer returning.

As previously mentioned, implementing recommendation algorithms that suggest books based on previous purchases or browsing can significantly increase sales.

Users appreciate personalised recommendations that help them discover new books. Ensuring the security of users' personal information and financial transactions is critical. Using SSL certificates and complying with security standards such as PCI DSS for credit card processing is a must.

Using social media to promote books and engage with an audience can help drive traffic to the website. In addition, integration with opinion-sharing platforms (Goodreads) can improve reader engagement.

5. Architectural solutions for building e-commerce systems for selling books

In the world of e-commerce, there are a number of well-known architectural solutions for building bookselling systems.

One of the most widely used models is microservices architecture, which allows the system to be divided into smaller, independent components. Each microservice is responsible for a specific function, such as order processing, book catalogue, or payment system, making it easier to expand and upgrade individual parts of the system.

Another important architectural approach is the use of server and client applications (client-server architecture). The server component processes the business logic, manages the database and responds to user requests, while the client application (website, mobile application) provides an interface for user interaction.

Another architectural model is event-driven architecture (EDA), which uses events to notify various system components of changes in their state. This enables more flexible and faster software systems, especially in the context of inventory management, order tracking and payment processing.

However, it is also necessary to consider the specifics of a particular e-shop's business and choose an architectural approach that meets its needs and objectives. When choosing an architectural solution for an e-commerce system, it is important to consider security, scalability, and performance.

On the basis of the following parameters, a comparison can be made of the known architectural solutions for building e-commerce systems for selling books: architectural solutions - monolithic, microservice, serverless, server; the technology stack used, in particular the use of platforms, frameworks, databases and programming languages (PHP, Python, Java, Node.js, MongoDB, MySQL, etc.); the choice of cloud solutions, in particular AWS, Azure, Google Cloud; scalability, i.e. support for high loads and the number of concurrent users, in terms of security methods, data protection methods, encryption, etc.; ease of integration with other software systems, in particular payment gateways, content management systems (CMS). e.g. support for high loads and number of concurrent users, in terms of security methods, data protection methods, encryption, access control; ease of integration with other software systems, in particular payment gateways, content management systems (CMS), analytics services; cost of implementation and support, in particular the cost of servers, maintenance and upgrades. A comparative description of architectural solutions for building e-commerce systems for selling books is given in Table 2.

However, it is also necessary to take into account the specifics of the business of a particular e-shop's business and choose an architectural approach that meets its needs and objectives. When choosing an architectural solution for an e-commerce system, it is important to consider security, scalability and performance.

A comparative analysis of architectural approaches to e-commerce systems revealed that microservice architectures are defined by flexibility and independence between components, but can lead to difficulties in managing services. Client-server architectures provide a clear separation of functions and effective scalability. However, they require proper configuration. Event-driven architectures provide agility and flexibility through the use of events, but require additional security measures and real-time event management.

Optimising the design and usability of e-commerce software systems for bookselling is an important aspect of creating a positive and effective user experience.

Table 2

Comparative characteristics of e-bookstore architectural solutions

Indicator	Monolithic (WooCommerce)	Microservices (Amazon)	Serverless (Firebase)
Architecture	Monolithic	Microserver	Serverless
Scalability	Average	High	High
Technologies	PHP, MySQL, Nginx	Java, Python, MongoDB, Kafka	Node.js, Firestore, AWS Lambda
Cloud solutions	Hosting on own server or VPS	AWS, Azure	Google Cloud, AWS
Security	Average	High	High
SEO optimization	Sufficient	High	Average
Integration	Easy with plugins	Flexibility via API	Limited
Cost	Low	High	Depends on the volume of use

The interface design should be attractive and intuitive. The store home page should be accessible and informative, providing users with easy access to books, promotions and personalised recommendations in different categories. Optimising the user experience includes making the interface responsive to user actions, making checkout easy, and simplifying the payment process. Efficient button layout, interactivity, and user-friendly search engines help users find and purchase books quickly.

Optimising the user journey also involves analysing and using purchase and browsing data to provide personalised recommendations and create tailored offers for each customer, which can improve user retention and increase the average checkout.

An important element of optimisation is taking into account user feedback and giving them the opportunity to leave a review. Positive reviews can influence a user's decision to choose a book, while feedback on the payment and delivery process can affect the overall shopping experience.

Optimising the design and usability of online bookstores is therefore a comprehensive approach aimed at creating a convenient and enjoyable user experience that helps to increase conversion and customer satisfaction.

Speed of interaction and minimisation of load time attract customer attention and simplify the buying process.

6. A stack of used technologies for building a book selling software system

PostgreSQL was chosen as the database for this study due to its advantages, as PostgreSQL is a powerful, open source relational database management system. It supports the SQL standard, allows data to be manipulated using complex queries, and provides a high level of reliability, security and performance. PostgreSQL is justified by features such as ACID support, extensibility, a large number of data types, integration with other programming languages (Python, Perl, Tcl), and high scalability.

In addition, PostgreSQL can run dynamic websites and web applications as an option of the LAMP stack, supports data logging, PostgreSQL is freely available under an open source licence, PostgreSQL supports geographic objects, so it can be used as a geospatial data store for location-based services and geographic information systems, and requires a low level of maintenance and administration.

All bookstore users can be divided into 2 categories: Users and Admins. User should have the following capabilities: browse book catalogues, search by title or sort books, leave a review for a book, add/remove from the cart, place an order, etc. The database schema includes User (a table with basic information about the user), Book (a table with information about the book), Basket (each user has a basket), Basket_book (a table that indicates the basket of a particular user and the book), Order (a table with information about the user's order), Order_item (information about a particular book in the order), Rating (a table of book ratings by users), Author (a table of book authors), Genre (a table of genres), etc. Figure 1 shows the scheme of the database of the book sales software system.

To log in to the software system, a user's login and password must be entered to ensure confidentiality. The server returns a token that is valid for a limited time. When a book is purchased in the store, the purchase data is automatically sent to the specified e-mail address, which helps to keep records and provides a convenient way to store information about purchases made.

We chose a framework in the Dart programming language called Flutter. Its key features are as follows. Flutter supports Google's Material Design, a design system that helps developers create digital experiences, so developers can use multiple visual and behavioural widgets when building an application.

Flutter has its own rendering engine for drawing widgets. WebStorm IDE and Intelij IDEA for software development were chosen as the software development environment. NodeJS was chosen for the server side for the following advantages: an asynchronous event-driven model that allows to avoid blocking I/O, improving the responsiveness and scalability of the application; a dynamic ecosystem and Node Package Manager (NPM).

7. Conclusions

Trends and prospects for the development of bookselling websites reflect changes in consumer behaviour, technological innovation and global economic conditions [13-17]. The growing popularity of e-books and audiobooks is driving the market. Consumers increasingly prefer the convenience and accessibility of digital formats, which may lead to further growth of platforms specialising in the sale of e-books and content subscriptions. The use of algorithms to personalise offers based on previous purchases and browsing is becoming the norm, helping e-book retailers to increase user engagement and conversion rates. Platforms that allow users to share reviews, recommendations and opinions about books on social media are becoming increasingly popular. Social media helps to create communities around literature, which can have a positive impact on sales. Book sales sites are beginning to offer not only books but also related content such as articles, reviews, videos and blogs, which can attract new audiences and retain existing users.

Book or audiobook subscription sites are becoming more common, as they allow users to access a wide range of titles without having to buy each book individually. AI is being used to improve customer service through chatbots.

Growing awareness of environmental issues may lead to increased demand for e-books and publications. Sites that combine online sales with traditional bookstores may become more successful by offering customers different ways to obtain books.

The introduction of new technologies, such as virtual reality (VR) for book presentations or augmented reality (AR) for content interaction, can provide new opportunities for user engagement.

Internationalisation and globalisation, innovation and technological development are the main trends in the development of book selling sites, and access to books in different languages and on different digital markets.

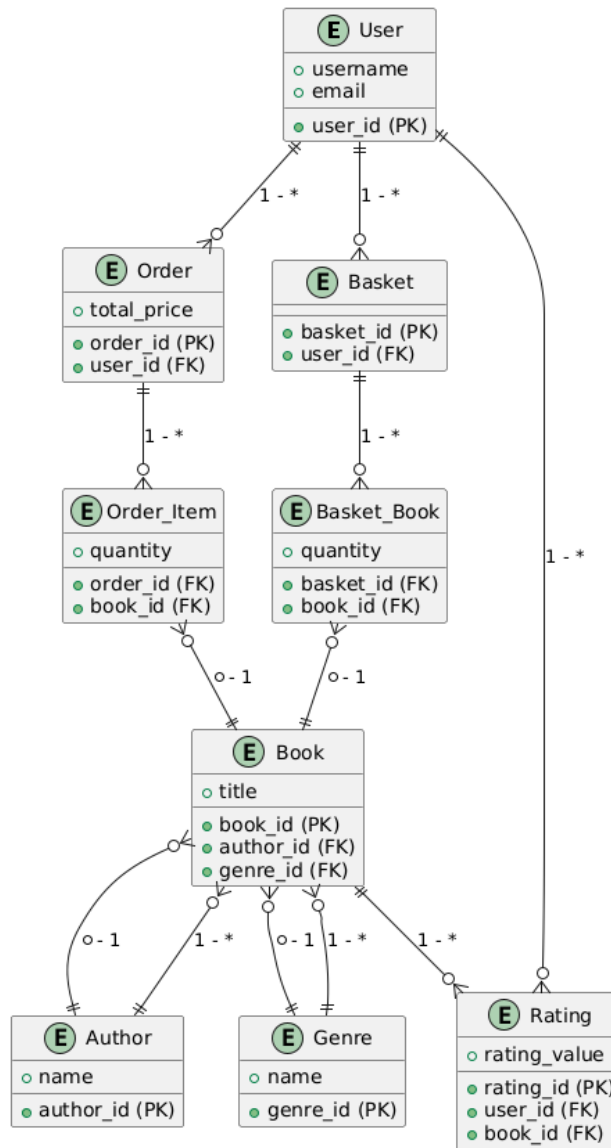


Figure 1: The scheme of the database of the software system of e-store book

To remain competitive, bookselling websites need to adopt modern technologies, such as artificial intelligence for personalised recommendations, automation of logistics processes, and the use of machine learning for demand analysis.

Priority should be given to optimising the user experience, including fast site loading, easy navigation, clear product categorisation and mobile responsiveness.

It is necessary to actively implement the sale of digital books (e-books) and subscription models for access to literature, which will meet the growing demand for electronic versions of books and create new sources of revenue.

Protecting users' personal data, secure transactions, and compliance with modern data protection standards are critical to building customer trust and promoting bookselling sites.

Engaging customers through social media and book-loving communities can help build loyalty and increase sales. Integration with platforms such as Goodreads can help expand audience and attract new readers.

Books are people's greatest treasures, linked to knowledge, culture and traditions, emotions and inspiration, wisdom, history, learning, science and development, which makes them particularly important in everyone's life thanks to digital platforms.

Declaration on Generative AI

The authors have not employed any Generative AI tools.

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