



ARTIFICIAL INTELLIGENCE SCANNERS IN LIBRARIES: INNOVATIONS FOR DIGITAL TRANSFORMATION

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Abstract:

Artificial intelligence scanners are advanced technology capable of fundamentally changing the processes of converting, storing, and managing library resources in electronic form. This article analyzes the directions of using artificial intelligence scanners in libraries, their main advantages, capabilities, and prospects for implementing artificial intelligence in library activities.

Keywords: Library, scanner, artificial intelligence, digitalization, electronic resource, book, publication.

Introduction

KUTUBXONALARDA SUN'YIY INTELLEKT SKANERLARI: RAQAMLI TRANSFORMATSIYA UCHUN INNOVATSIYALAR

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Annotatsiya

Sun'iy intellekt skanerlari kutubxona resurslarini elektron ko'rinishga o'tkazish, saqlash va boshqarish jarayonlarini tubdan o'zgartirishga qodir bo'lgan ilg'or texnologiyadir. Ushbu maqolada kutubxonalarda sun'iy intellekt skanerlarini qo'llash yo'nalishlari, ularning asosiy afzalliklari, imkoniyatlari, shuningdek, sun'iy intellektni kutubxona faoliyatiga joriy etish istiqbollari tahlil qilinadi.



Kalit so'zlar. Kutubxona, skaner, sun'iy intellekt, raqamlashtirish, elektron resurs, kitob, nashr.

Аннотация

Сканеры с искусственным интеллектом - это передовая технология, способная коренным образом изменить процессы преобразования, хранения и управления библиотечными ресурсами в электронном виде. В данной статье анализируются направления применения сканеров с искусственным интеллектом в библиотеках, их основные преимущества, возможности, а также перспективы внедрения искусственного интеллекта в библиотечную деятельность.

Ключевые слова: Библиотека, сканер, искусственный интеллект, цифровизация, электронный ресурс, книга, издание.

Introduction

Nowadays, society is experiencing the era of artificial intelligence in an information-driven world. During this period, artificial intelligence-based technology and innovations are emerging in all fields. Modern libraries are also facing the necessity to adapt to the demands of the digital age due to the increasing volume of information, the speed of data access, and the need to preserve rare materials. Traditional digitization methods, which rely on manual labor and outdated equipment, are no longer sufficiently effective. Now, AI-powered scanners have emerged, integrating advanced artificial intelligence systems, computer vision, and robotics technologies. These innovations open up significant opportunities for automating processes, improving digitization quality, and enhancing data management. The main objective of this article is to highlight the capabilities of AI-powered scanners in library and information activities, assess their advantages, and define future development directions.

It is well known that one of the first and most important stages of book digitization is scanning. Although traditional methods of scanning books and documents have stood the test of time, they have several limitations, especially when it comes to old or damaged books. These methods require considerable time and effort. Additionally, in traditional scanning, the pages of old books and documents are



often fragile, which may lead to tearing or damage during the scanning process. The necessity of opening books to a 180-degree angle can result in damage to their covers. Manually turning book pages and adjusting the scanner for each fold is time-consuming. Traditional scanners are also unable to accurately capture text distortions caused by page curvature or paper defects.

AI-powered scanners are fundamentally transforming library processes by automating daily tasks and increasing the accuracy of data processing. Below, we will examine the main applications of various AI-driven scanners in library and information activities:

In the field of automatic book digitization, AI-powered scanners solve issues such as contactless scanning and error correction. Contactless scanning is an innovative method of digitizing documents in which the scanning device does not physically touch book pages. This technology is particularly essential when working with rare, ancient, or fragile editions, as preserving the original copies is of utmost importance. The introduction of AI-powered scanners with contactless technology, such as the Kirtas APT BookScan, allows libraries to carefully preserve materials while ensuring highly efficient digitization. The operational principle of contactless scanners is based on robotic systems, optical technologies, and artificial intelligence for error correction. These scanners are equipped with robotic manipulators that use vacuum suction or air currents to carefully turn book pages. For instance, in the Kirtas APT BookScan, pages are separated by an air stream, eliminating mechanical impact. High-sensitivity cameras (up to 600 dpi resolution) capture images of pages at optimal angles, while a multi-layer lighting system is used to remove glare and shadows. [1]

In the field of error correction, AI-powered scanners address challenges such as correcting page curvature, removing shadows and glare, and rectifying text deformations in original materials (books, journals, and similar publications). Error correction is a crucial step in processing scanned books, especially when working with aged editions or books that cannot be fully opened. Computer vision and artificial intelligence (AI) algorithms enable the automatic correction of defects by transforming curved, darkened, or deformed pages into precise digital copies. Shadows from book covers or glare from glossy paper can obstruct readability. To overcome this issue, multi-level lighting is utilized. Scanners such as the Zeutschel



Omniscan capture multiple images under different lighting conditions, which AI then integrates by removing shadows and improving the final output. [2]

It is well known that when scanning old publications, texts sometimes undergo deformations. Deformations occur due to uneven printing, paper damage, or aging. AI-powered scanners use text segmentation, morphological operations, and generative adversarial networks (GANs) to eliminate text deformations. Artificial intelligence algorithms ignore background artifacts (dust, stains) while isolating individual characters and lines.

In the field of optical character recognition (OCR), the issue of multilingual text recognition is addressed. Modern AI-based OCR algorithms, such as ABBYY FineReader, Tesseract, and Google Cloud Vision API, can recognize texts in hundreds of languages, including rare, ancient, and even extinct languages. This is achieved through the following technologies: [3]

Unicode support. The systems cover all Unicode characters, including ideograms (Chinese, Japanese), Arabic script, Devanagari, and Glagolitic alphabets. For example, Tesseract supports over 100 languages, including Old Slavic and Sanskrit. Transfer learning. For rare languages (such as Ainu or Manchu), models are trained using pre-trained neural network layers from widely spoken languages based on small datasets.

Adaptation to historical scripts. Algorithms analyze the characteristics of ancient fonts, such as Gothic Fraktur or Church Slavonic Cyrillic script. For example, the Transkribus project specializes in recognizing medieval manuscripts. In 2023, the National Library of Israel digitized 16th-century scrolls in Ladino (Judeo-Spanish) using ABBYY FineReader, achieving 95% accuracy.

Handwritten text recognition. Recognizing handwritten text is one of the most complex OCR tasks. In this case, convolutional neural networks (CNNs) analyze the geometric patterns of letters. For example, Google's HWR+ project recognizes handwritten records in over 50 languages.

In the field of metadata processing, AI-powered scanners use Natural Language Processing (NLP) to process metadata. Metadata is structured information that describes resources (author, title, keywords, genre, publication date, etc.) and serves as the basis for cataloging, searching, and managing library collections. AI scanners integrated with NLP technologies automate metadata generation, reducing document processing time and improving accuracy.



In the field of annotation and abstract generation, AI-powered scanners enable the rapid creation of document summaries, facilitating cataloging, searching, and interaction with users. [4] Modern methods are divided into two approaches:

Extractive summarization. This method extracts the most important sentences from the original text without changing their wording. The importance of sentences is determined based on their relationship with other parts of the text. The more frequently a sentence is mentioned or associated with key terms, the higher its weight.

Abstractive summarization. This method rephrases and summarizes the document's content, creating new expressions. It requires a deep understanding of context. In this case, BART, PEGASUS, and T5 neural networks learn to extract and rephrase the key points from "text → annotation" pairs.

Currently, numerous software tools are designed for utilizing artificial intelligence in book scanning, with ABBYY FineReader being one of the most widely used in library and information activities. ABBYY FineReader is software designed for scanning documents and converting them into digital format using optical character recognition (OCR) technology. Based on artificial intelligence, the software performs all processes from book scanning to transforming them into electronic form.

Google Books is an electronic library that scans millions of books and makes them available to users online. [5] Google Books automatically scans, recognizes, and indexes books using artificial intelligence. Additionally, it allows for the automatic editing and enhancement of book covers, pages, and other elements.

ScanTailor is software designed for the automatic editing and enhancement of scanned documents. With the help of AI, it straightens pages, removes backgrounds, and improves text clarity, significantly enhancing the quality of scanned books.

BookScan is a specialized device for fast and efficient book scanning. It uses AI to automatically turn pages, recognize text, and correct errors, speeding up the scanning process and improving its quality.

Adobe Acrobat is software for creating, editing, and managing PDF documents. It recognizes scanned documents using AI, processes text, and automatically edits documents. Additionally, it provides the ability to translate text into different languages.



In conclusion, AI-powered scanners have become an integral part of library development, transforming them from book storage facilities into active digital systems. These AI-based technologies go beyond automating simple tasks; they redefine knowledge preservation, processing, and distribution, opening new opportunities for science, education, and culture. AI-powered scanners enable the digitization of delicate materials, from medieval manuscripts to early 20th-century newspapers. Technologies such as 3D modeling and AI-assisted restoration provide a level of precision unattainable through manual processing. AI-powered scanners are not just tools but accelerators of the digital transformation of libraries. They turn libraries into innovative hubs where the past meets the future, and knowledge becomes dynamic and interactive. Now, libraries must not only integrate technology but also reconsider their role and mission in the digital age.

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