

Comparing Net Interactive Document System with Non-Interactive Digital Annotation Approaches

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Abstract: *Interactivity is an essential part of learning and development, as it teaches people how to collaborate, communicate respectfully, exchange information, and hone their skills. Social networks and computer games are a few examples of applications that allow interactivity and foster more effective learning environments. However, while technology has enabled the creation of large websites, e-books, and online educational systems, many digital libraries and annotation approaches do not provide users with the opportunity to interact with the material or other readers. Users can only share annotated documents in a standard format through email or other means and they are limited to annotating documents without the ability to ask questions, initiate discussions, or give feedback on the content presented. Additionally, embedding annotation data into a document can disrupt its structure. After conducting extensive research on digital annotation tools that enable interactivity, we stumbled upon a system known as NID (Net Interactive Document). Our thorough examination of NID concludes that it outperforms other digital annotation methods in several ways. This system supports the feedback possibility, where different groups of experts can provide information and insights. Additionally, it allows readers to discuss various materials, leading to continuous content growth and more informative documents. One of the significant advantages of NID is that it enables users to create annotations to any extent without ruining the structure of a document. Moreover, NID uses graphical image addresses that enable users to include relevant images or videos from the internet into a document without infringing on copyright laws. So, NID provides a collaborative environment for readers and knowledge providers, making it a valuable educational tool as well as a means of presenting and improving information. We strongly recommend its use in online educational systems, digital libraries, and non-learning settings (such as commercial spaces) due to its wide range of interactivity.*

Index Terms: *Digital annotation, digital library, discussion, e-book, feedback, information, interactivity, net interactive document (NID)*

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1. INTRODUCTION

IN recent years, digital documents have gained popularity over printed ones due to several reasons. They are portable, cost-effective, environmentally friendly, and easily accessible. However, some individuals still prefer printed books as they can annotate documents using a pencil. To encourage these individuals to make the switch to digital reading, it is necessary to adopt new technologies that offer digital annotation tools. These tools should include features such as commenting and highlighting documents, as well as the ability to incorporate multimedia elements like videos, images, and links to other pertinent sources. By strategically incorporating these types of annotations in the appropriate locations, content can become more informative and engaging for readers. For instance, consider an application within a car company that provides various explanations or annotations tailored to different groups of customers, sales representatives, engineers, and repair crews. This approach can make the application more impressive and effective in conveying information to its intended audience [20]. Annotation has numerous applications in various fields, including sports videos where automated annotations can extract essential information and identify players [4]. In the tourism and public transportation industries, policymakers can utilize the annotation capabilities of the global positioning system (GPS) to predict human mobility patterns [16] and [36]. In organizing images more efficiently, image annotation can be used to add additional information to images, such as labels, captions, and descriptions. This can help to provide context for the image and make it easier to search and retrieve in the future [5], [9], and [29]. The educational system can also benefit from digital annotation tools to promote academic success, as evidenced by the studies conducted by [18] and [23]. There are two methods available for annotating digital documents: desktop annotation software and

web-based systems. Although both systems provide a range of crucial annotation tools, they fall short in terms of user interactivity. As a result, there is a need for innovative technology that can foster collaboration among users, allowing them to engage and exchange information more effectively. Social networks and computer games are excellent examples of such interactive platforms. Well-designed games, such as Minecraft, have the potential to offer players valuable insights into specific subjects or ignite their curiosity, making them ideal for learning environments [19]. In [22], a study examined the influence of interaction in the game industry on foreign language learning and concluded that incorporating interactivity into language learning can efficiently enhance vocabulary retention. Today, children spend more time playing digital games than outdoor sports activities, however, interactive video games motivate people for more physical activity and promote a healthy lifestyle [14] and [24]. Interactivity is also a valuable tool in online shopping environments as it enables customers to explore various products and influences their purchasing decisions [15]. Overall, the benefits of interactivity in social networks and computer games are evident, and it is crucial to expand this technology to other areas such as large websites, digital libraries, and online education systems. A recent study [3] has demonstrated that the lack of interaction in virtual classrooms during the COVID-19 pandemic can have negative effects on learners' satisfaction levels and lead to psychological problems. Therefore, promoting interaction across all digital platforms is essential. This paper presents a comprehensive review of both online and offline digital annotation applications. It discusses the advantages and limitations of various approaches and compares them to the technologies offered by the NID system. Ultimately, we conclude that NID surpasses all other approaches and plays a critical role in shaping digital society and advancing knowledge development.

2. OFFLINE ANNOTATION SYSTEMS

Annotation software such as Adobe Reader, Nitro, UPDF, PDF Annotator, and many other applications allow users to write comments on documents, which helps users structure content well and recall important information later. In this section, some of the essential features of the UPDF annotator are discussed. As shown in Figure 1, the File menu, located in the top left corner of the screen, provides users with the option to open a PDF document from their device and edit it. The Reader panel is a useful tool that allows users to adjust the content of a PDF document. With the zoom feature, users can

easily zoom in and out on the content to get a closer look or see more of the page. The percentage zoom setting is also available, which allows users to customize their screen according to their preferences. The page number feature in this panel is especially beneficial for users who require swift navigation through extensive documents, enabling them to easily locate and edit specific pages. The Comment panel is another great feature that allows users to highlight important parts of the document using colorful markers. They can also use strikethrough and underlining features to emphasize different parts of the PDF. Using the Text comment and Text box options, users can write comments anywhere on the document with various properties such as font style, size, and color. The Rectangle tool enables them to create text inside a rectangle with customizable border thickness and background color. Sticky notes and lines can also be added to a document. This helps in drawing attention to specific areas that require focus. Annotations are editable, and an eraser tool can be used to remove them. The Edit PDF panel offers users a plethora of supplementary functionalities. These encompass the capability to generate links to web pages or documents and also integrate images. The Text tool located in this panel enables users to select and modify specific sections of the document, similar to a Word file. This functionality allows for tasks such as relocating, deleting, typing, or inserting desired content. The Organize Pages panel in a PDF editor allows users to add blank pages or pages from other documents to their PDF files. The Crop panel enables users to remove or copy specific parts of a document and paste them onto another page or document. To safeguard the file and its contents, users can apply the Watermark panel on the left side. They can customize the font style, color, and transparency of the watermark using the Opacity button. The Thumbnail panel provides users with a miniature view of all pages in the PDF file, allowing easy navigation to any page by clicking on its thumbnail image. The Bookmarks panel helps users save their progress while reading a document for later retrieval. The OCR panel stands for Optical Character Recognition and converts scanned PDF files into searchable and editable text. The UPDF software provides users with the ability to convert PDF files into various formats, including Word, PowerPoint, Excel, Image, XML, and Text using the Export icon. Additionally, users can share documents through email directly using the Email icon. To ensure security, users can encrypt their PDF files using the Protect Using Password panel located on the left side of the interface. This feature restricts access to sensitive information within a PDF file

to authorized individuals only. Figure 2 illustrates an annotated document created using UPDF software. As is apparent, offline annotation systems, such as UPDF Annotator, are valuable tools for annotating documents. However, they do come with certain limitations. Firstly, they are not free and require either limited trials or paid licenses. Secondly, some of these systems only

work with Windows operating systems and need to be installed on the device. Thirdly, their scope is local which means that user interactivity is limited and documents can only be shared with others like standard PDF files through email. Moreover, creating annotations can ruin the structure of the document as shown in Figure 2.

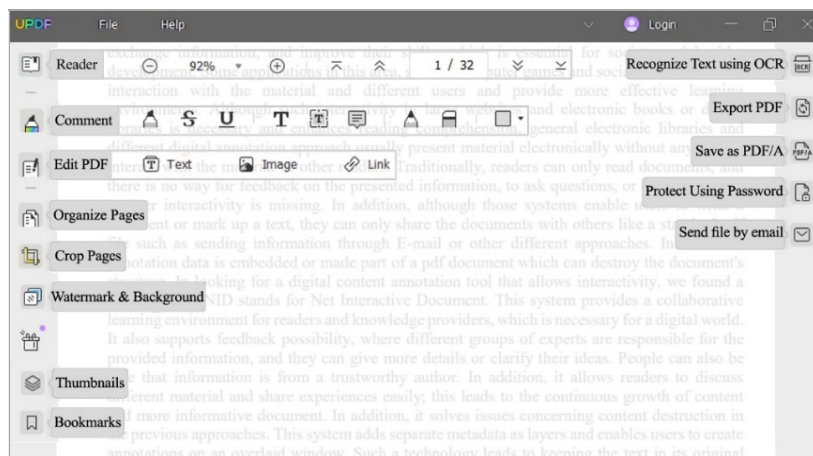


Figure 1: Essential annotation tools in UPDF software [39].

Therefore, while offline annotation systems offer a range of useful annotation features, they also have significant drawbacks that limit their effectiveness in the digital age.

3. ONLINE ANNOTATION SYSTEM

In today's digital age, online annotation systems are gaining popularity due to their efficiency in engaging with digital content and facilitating communication among users. These systems serve various purposes such as research, education, and remote learning. Some of the widely used online annotation systems include PDF Escape, Markup Hero, Google Docs, Hypothesis, and Perusall. PDF Escape and Google Docs are two web-based tools that offer users a convenient way to annotate their documents. These tools provide a range of annotation options, including text highlighting, underlining, strikethrough, drawing tools, linking to other documents or web pages, and inserting images. The annotated document can be shared through email or cloud storage services like Dropbox or Google Drive. To collaborate on a document in Google Docs with multiple people, users need to enter the email addresses of the people they want to invite and add a note. Different permission levels can be assigned to different users, such as allowing them to edit or just view the document. If another user suggests Google Docs, the recipient has the option of accepting or rejecting it. In [28], the authors explore the utilization of Google Docs in

online English teaching to enhance students' writing skills, especially during the COVID-19 pandemic. They conducted a case study using Google Docs as a tool to assist learners in producing high-quality writing. The study involved 45 first-year English-majored students who had to study both traditional and online courses. The findings showed that Google Docs was useful in developing writing abilities and that students had a positive attitude towards using it for their online courses. The hypothesis is also a powerful social annotation tool that enables users to annotate web content in both public and private groups. The tool appears as a sidebar drawer on the right-hand side of the document, allowing users to select the text, highlight it, and add annotations by typing text, formatting it, and adding hyperlinks, images, math equations, and tags. Additionally, users can respond to existing annotations and conceal highlights to view the text clearly. The hypothesis is ideal for personal conversations with friends and colleagues and can also be easily integrated into formal education settings by installing it in the learning management system. The tool is LTI-compliant and works across different learning management systems such as Sakai, Moodle, Blackboard Learn, and Canvas. Instructors can use the Hypothesis to deliver annotatable readings to their students. They can grade annotations using Hypothesis within their LMS platform and give private comments in Canvas. It's possible to divide students into small groups to annotate the text separately, without seeing annotations from

other groups. JSTOR, a digital library with access to over 12 million academic articles, books, and images, has integrated with Hypothesis. This integration allows instructors at certain schools to make Hypothesis assignments using JSTOR's texts and ebooks in their LMS [40]. The Hypothesis has seen a significant increase in usage in 2019. Over 8 million annotations have been created on more than 800,000 documents by over 300,000 users. Additionally, over 500 schools have installed the Hypothesis LMS app [13]. Perusall is another social annotation tool that functions similarly to the Hypothesis system. It is a platform that was created as a research project at Harvard University to serve students in their classes. In 2015, they decided to expand and build a business around the platform, which now serves 2 million students across 3,000 educational institutions in 90 countries [35]. In [21], the author examined the use of Perusall among university students in three classes to determine its effect on their motivation for curriculum-based academic reading. The results showed that social annotations enhanced students' reading motivation and they preferred reading academic texts online towards the end of the study. The changes in their motivation were attributed to peer interaction and coaching, the interaction between readers and texts, and ongoing automated grading provided by Perusall. Overall, students appreciated how Perusall helped them read and discuss course material together. This study highlights the potential impact of social annotation tools on students' collaborative relationships, online learning communities, and reading motivation improvement. Web-based annotation systems offer several advantages, but they also come with some limitations. One of the main challenges is

the time-consuming process of repeatedly uploading content and adding diverse annotations. Slow internet connectivity can also hinder the uploading of large files, making it difficult or impossible to complete the upload process. Power outages can lead to the loss of editing data, which can be frustrating for users. Furthermore, embedding annotation data in the PDF document can disrupt the structure of the content in some cases, although systems like Hypothesis allow for hiding created annotations. Additionally, some online annotation systems require a subscription or payment for advanced features or increased storage capacity. For example, Hypothesis provides a free basic plan for individual users but offers a paid premium plan for organizations and institutions. Another potential disadvantage is security concerns associated with storing sensitive information on cloud-based platforms. Users must ensure that their documents are secure and protected from unauthorized access. WKO (Wirtschaftskammer Österreich), which represents Austrian businesses, advocates for data localization laws to increase data security and protect sensitive information from foreign governments or hackers. These laws would require companies to store their data within Austria's borders. To mitigate the challenges posed by online and offline annotation systems, we suggest utilizing NID as a comprehensive knowledge management solution. NID offers advanced annotation tools, user interaction, and access control features that provide companies with greater control over their data compared to solutions provided by companies such as Google. In the following section, we will delve deeper into the various NID technologies available.



Figure 2: Creating annotations using UPDF software [31].

4. NET INTERACTIVE DOCUMENT (NID) SYSTEM

The growth of technology has had a significant impact on the landscape of online learning and

integrating digital content with the interactive feature can further enrich the learning experience. The NID system is a web-based platform that enables users to engage with digital

content, fosters collaboration among users, and offers numerous tools for annotating digital content (see Figure 3). As it is shown, the settings tab on the right side of the screen offers three distinct options. The first option is Display mode, which allows users to choose from a variety of viewing options such as full screen, image, book, scroll, and gallery views. In scroll view mode, users can easily navigate through all pages by scrolling horizontally. Gallery view displays all sheets in a collection of photos, making it effortless for users to select their desired page. The second option is the Interface language that enables users to select their preferred language from a range of options including English, German, and Serbian. The third option is the Menu tab, which allows users to switch to the Full menu and see all NID features. While users can read content and add annotations anonymously, they must register and log in to access all features, including modifying created annotations. The Group button allows information providers to display annotations exclusively to a specific set of readers or create a small group for discussion purposes. Users can specify the type of access provided to the document, such as arbitrary, public, and private groups. In arbitrary cases, each group may have access to a different document and see varying annotations within documents. In private cases, only the person who created the annotation can view it. The AI panel in NID offers advanced artificial intelligence capabilities such as object detection and search within a book. The Change Layout tool allows users to arrange their workspace by displaying multiple sheets on one screen for easy comparison. Users can add slots on all sides of each page and manipulate them independently. It's important to note that each page can come from different servers with varying languages. Additionally, there is a panel that displays the current page number, making it

easy to navigate to specific pages. The Book Detail tab provides users with some information about the book, including its title, author(s), publisher, volume number, number of pages, and other pertinent details. Furthermore, on the cover of each book, there is a number that indicates how many times the document has been accessed. This feature serves as a valuable metric for assessing the document's content and popularity. Citation functionality is also available to assist readers in locating sources in standard formats. The Transclusion panel enables users to select and share specific sections of a document. Navigation through each page is made simple with small arrows located on both sides of the page. Furthermore, NID users have the option to customize their toolbar icon size. The system also supports high-resolution image uploads and enables zooming capabilities through a set of icons situated in the lower right-hand corner. In Maurer's work [12], a picture of a city with a small rectangle inside was displayed. By zooming in on the blue spot 40 times or more, users can identify it as a swimming pool (refer to Figure 4). An automatic table of contents can be activated on the left side of each page if such a table was added when the document was uploaded. The image manipulation panel allows users to adjust brightness, contrast, saturation, grayscale, inversion, and mirror effects on the current page, as well as rotate pages to their desired orientation. The Help option guides how to create annotations and is available in English and German languages. Users can place a question mark anywhere on the document to ask a question, which will be answered by an expert subsequently. The console tab provides statistical information about what is currently on the NID server and allows users to perform various actions based on their registration type. The Dashboard displays categories such as articles, books, annotations, groups, quizzes, and

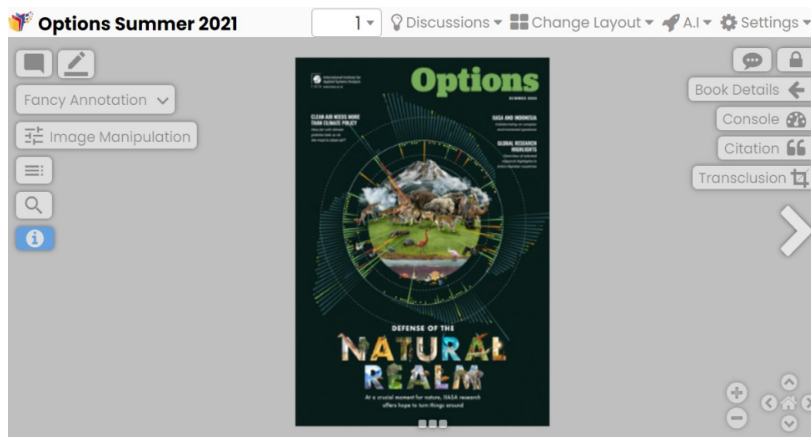


Figure 3: Essential features in the NID system [33].

active users for easy navigation. The Article and Groups tabs are designed to aid authorized users in managing articles and groups. The user annotation tab permits users to load annotations based on the book and creator. This feature is particularly useful for collaborative projects with multiple users working on the same document. The NID user panel provides a comprehensive list of users along with relevant information such as full name, email address, group type, and profile picture. Additionally, there is a Broadcast

Message button that allows users to send messages to specific groups of people. This feature is useful for disseminating important announcements or updates. The File System tab illustrates all files added to the NID platform. The My Profile tab allows registered users to modify their personal information such as their name, profile picture, account name, and password. This feature ensures that each user has control over their personal information and can update it as needed. Additionally, NID provides users with



Figure 4: Uploading high-resolution picture and zooming capabilities in NID [12].

the option to create quizzes. To do so, users must click on the quiz tab and fill in three required fields: the quiz title, group type, and book name where the question should be placed. Once these fields are filled out, users can pose a question for the quiz by using the Add Quiz Question tab from the Quiz category. This will provide additional fields that need to be filled out, such as specifying the page number of the book where the question should be displayed, providing different answer options, and selecting the correct answer using Correct Options. Quiz management is also possible. For more information and an example of quiz creation, please refer to [37]. Creating online quizzes is an effective way for instructors to assess their students' skills, perceptions, strengths, and

weaknesses. It also enables teachers to identify areas where they need to provide more explanations or adjust their teaching style. Once students submit their answers, the system provides immediate feedback on whether they have answered correctly. There exist two types of quizzes: one that displays the correct answers to the user and another that only allows teachers to evaluate a student's performance without revealing the correct answers. The latter can be used for grading purposes or to send a message to a student to review a specific part of the quiz and retake it. Another valuable feature of NID is its search engine, which enables users to locate specific words or phrases within a document. To access the search function, users can click on the small magnifying glass icon located on the

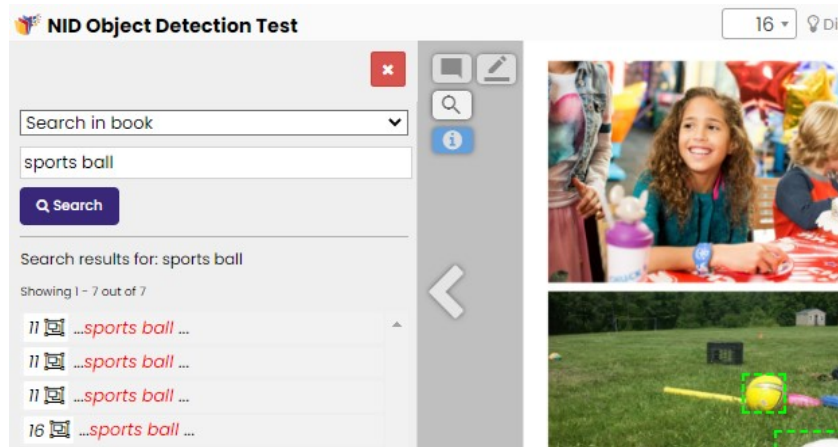


Figure 5: Object detection in the NID system [27].

left side of the screen. There are two types of searches available: one that searches within the text of the book and another that searches within any annotations added to the document. NID's search engine utilizes advanced optical character recognition (OCR) technology to identify and highlight any objects related to the search term. For instance, if a user searches for "sports ball," NID not only highlights any instances of those words in the text, but it also detects any images of sports balls within the document. Additionally, instead of simply highlighting the relevant text, NID displays the number of all pages that contain that word or phrase on the left side of the current page. Clicking on one result directs the user to the corresponding page where objects are detected with a thin dotted green rectangle (refer to Figure 5). NID's search engine is powered by artificial intelligence and can identify and distinguish up to 80 different objects. The system is constantly improving its capabilities to detect even more objects. Another important feature of NID search is that with one query one can search all books in a certain category, thus saving the user to do multiple searches for a term in many books. For a demonstration of how this technology works, please refer to the NID object detection test document authored by Zaka in

2021 [26]. Another essential feature of NID is the Comment panel, which allows users to create stylish annotations by simply clicking on the pencil icon and drawing a rectangle anywhere on the content (refer to Figure 6). By default, the rectangle color is blue, but users can customize it by selecting different colors from the Border-Color panel. Users can also choose from Ellipse, Freehand, and Polygon panels to create different contour shapes. The Border-Type option provides various border styles and widths such as solid, thick, and dash. To change the background color of text and the default style of text annotation, users can click on the Fill color icon and the Paragraph button, respectively. Bullet and numbered lists are available to help convey information quickly. Special characters, dates, and times can also be added to content for further customization. The Text panel in NID provides users with the option to add sticky notes to any section of a document. These notes can be conveniently accessed by simply hovering over them with the cursor. Furthermore, NID permits users to arrange annotated content or data in rows and columns using tables. Users have the flexibility to customize their tables by including captions, adding or removing rows, and columns. NID provides users with the ability to

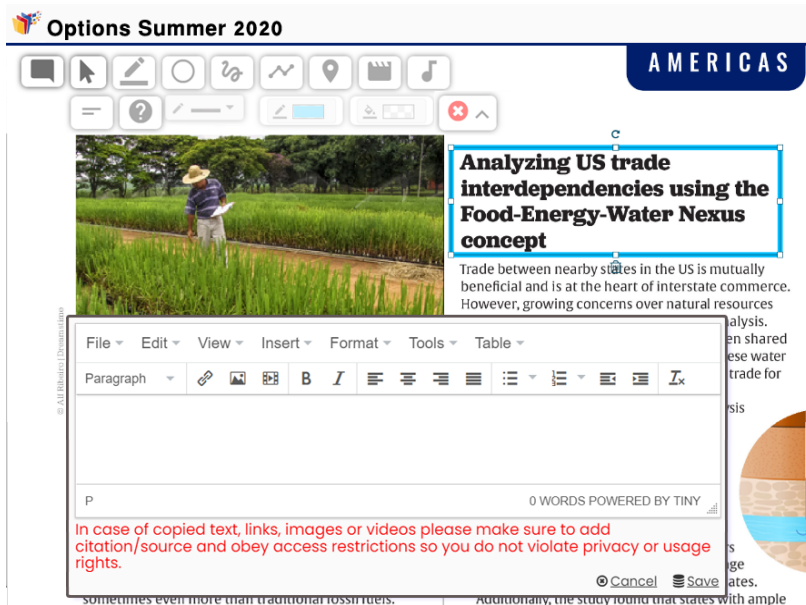


Figure 6: Annotation tools in the NID system [32].

link to webpages or embed videos, audio, and images. Unlike previous methods, NID allows users to embed videos and add annotations to the desired extent without altering the content's structure. This is achieved by adding separate metadata layers and enabling users to create annotations in an overlaid window. The contrast between utilizing NID for annotated documents and other approaches is apparent when comparing Figures 2 and 7. Users can add multiple images or a combination of short text with links in their annotations, which may render the entire annotation invisible. Users can access the complete content by scrolling down or clicking on new windows as depicted on the right side of Figure 7. Furthermore, NID provides users with the ability to easily insert images from the internet into their documents without worrying about copyright infringement. Normally, using copyrighted images is prohibited, and users must provide information about the source of the image. However, NID solves this issue by pointing to the image source instead of copying it to its server. Additionally, users can upload their pictures, but only open-source or personal images are permitted. Users can also adjust the size of their images and add descriptions or captions to provide context for their photos. One of the significant benefits of NID is its interactive capabilities, making it an excellent platform for virtual environments. Unlike other annotation

methods, NID includes feedback and discussion features and allows users to ask questions, share experiences, and discuss topics. The ability to connect with others leads to greater understanding and collaboration toward finding solutions to complex issues. Additionally, NID is user-friendly and easy to use; there is no need to install software or upload/download content each time. This makes it effortless for users to participate in online discussions. Figure 8 provides an excellent illustration of how NID users can engage in a focused discussion on a specific topic. In this example, visitors are participating in a conversation about climate change and its impact on the environment. The discussion is quite extensive and can be viewed in its entirety by scrolling down the page. One noteworthy feature of NID is that when a discussion is taking place on a particular page, the discussion lamp illuminates in blue. This helps users quickly identify pages where active conversations are happening. Additionally, if a user initiates the conversation, the icon appears as a black lamp, indicating that they started the discussion. The final point to consider is the importance of feedback in today's digital age. A webpage must have feedback options and someone accountable for the information presented. Unfortunately, many virtual environments and digital annotation systems overlook this crucial technology. However, NID

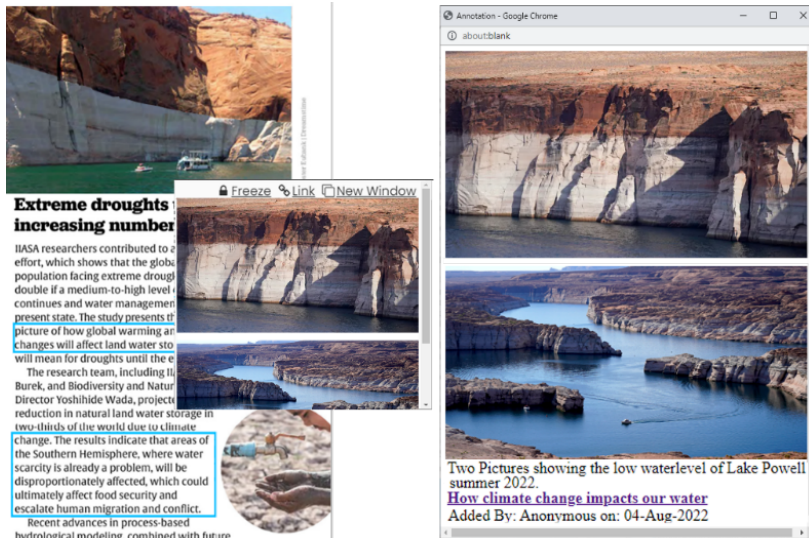


Figure 7: Creating annotation using the NID system [34].

provides a solution by offering a Feedback button on each page where users can anonymously submit their ideas or questions to a team of experts knowledgeable about the topic at hand. This group can offer further insights or explanations to address any uncertainties related to specific topics. In cases where readers require more information from the author, they can provide their email addresses for further communication. It is important to note that feedback is not directed toward a single individual but rather toward a team of experts. This helps avoid overwhelming information providers with numerous reader inquiries.

Overall, NID offers a wide range of digital annotation tools that are both interactive and easy to use, as noted in sources [14] and [38]. Users can gain a better understanding of NID's functionality and how readers have utilized its various annotations by visiting the platform's main page [25]. On the entry page of NID, users can search for books based on author, title, or subject. Moreover, the Articles panel located on the top right side allows users to search for different articles. With its integrated Wiki feature, NID is poised to play a significant role in the future.

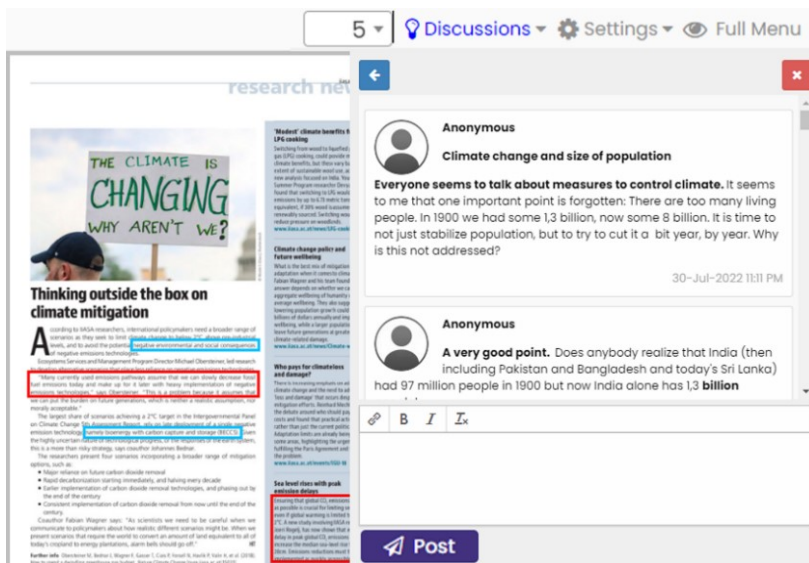


Figure 8: Discussion platform within the NID system [30].

5. NID APPLICATION AREAS

The NID system has a wide range of applications across various fields. A study conducted by Maurer [11] demonstrated the successful implementation of the NID system in the "FIDEL" project with a school in Graz, Austria. The project received an award from the Ministry of Education and Research for its innovative use of the NID system. The primary objective of this project was to bridge the gap between students, computers, and the Internet. To achieve this goal, students were assigned to read and annotate various documents across different categories. The outcome of the project revealed that through NID, students gained proficiency in working with computers and software while also learning about copyright infringement when embedding videos or images into their documents. Furthermore, the project fostered a passion for learning among students that were comparable to their enthusiasm for computer gaming. Controlled communication within NID has proven to be highly effective in eliminating fake news. This feature can be particularly beneficial for digital newspapers, as social media platforms are often inundated with information that is difficult to differentiate between fact and fiction. With NID's help, political parties can engage in discussions and express their opinions while providing sufficient evidence or reasons to support or reject the information presented. All conversations within NID are visible globally without censorship, making NID a reliable platform for sharing accurate information across the digital world. Furthermore, NID can be utilized by companies, online stores, and exhibitions to showcase their products through short videos or photos. This interactive technology also allows them to receive feedback, suggestions, and questions from consumers. In public projects and political decisions, NID can help individuals become more engaged in various events. As a result, the use of NID creates a mutually beneficial situation for both parties involved. NID is also a valuable resource for travelers as it has great potential for providing tourists with easy access to comprehensive information about their destination. For instance, tourists visiting Graz can utilize NID to access a document titled "Our (Green) Graz - See and Experience". This document contains links to other books or articles with pictures and annotations, making it easy for users to find exactly what they're looking for. For example, if a user is interested in visiting churches in Graz, they can simply search for the word "Kirche" within the annotations. This will bring up a list of seven results on the left side of the screen. By

clicking on each result, users can view a green rectangle on the right side of the screen that provides detailed information about the particular location, as shown in Figure 9. Furthermore, NID is in collaboration with various servers, such as IASA Options magazine [7], Joannovum [8], and Austria-Forum [2]. It establishes a network of information and promotes reports and research of multiple organizations by providing links and backlinks between different pages. Overall, NID's collaboration with other institutes demonstrates its commitment to providing high-quality and diverse information to its users. Moreover, the entries of Austria-Forum can be converted into articles in the Wiki system associated with NID, see Neuigkeiten in Austria-Forum under Neues bei NID like ABC der Volkskunde [1]. Additionally, NID has the potential to facilitate conference proceedings. For instance, in EuroSPI² [6], users can access the titles, and abstracts of numerous papers, view the full presentations, and provide feedback to the authors through NID. During our research, we came across another useful application area for a table of contents. It can provide users with links to different books that offer more comprehensive information on the topic at hand. This way, users can access a wealth of knowledge without disturbing the structure of the content they are currently reading, please see reference [17]. NID documents can also serve as knowledge repositories within companies. Employees can continually add information, which remains accessible even when personnel changes occur. In this way, NID can be viewed as a small interactive knowledge management system. For more details about the application area of the NID, please refer to [10] and [11].

6. CONCLUSION

In conclusion, the NID system has successfully fostered a more connected online community. Its seamless integration of interactivity with digital content has enabled users to initiate discussions and provide feedback on the information presented. In addition, with its ability to include multimedia material from the Internet without violating copyright laws and add annotations to the required extent while preserving the original structure of the content, NID is a versatile tool that can be used for learning, presenting, and enhancing information. It preserves knowledge collectively from different sources and people. Developed by Bilal Zaka and Hermann Maurer, NID is set to gain worldwide recognition for its interactivity scope. So, It is likely that other software providers will adopt similar ideas from NID, making it both a product and a showcase of research ideas. In summary, the NID system has

revolutionized our interaction with digital content, and its potential to shape the future of online communities cannot be overstated. We highly recommend online learning systems, electronic libraries, and commercial spaces incorporate the NID system into their platforms to promote collaboration among users and improve the overall digital experience.

7. FUTURE WORK

The future of libraries is bright but requires a willingness to embrace change and a commitment to innovation. They must continue to evolve and adapt as technology advances. While the current digital annotation system (NID) has

made significant strides in meeting essential needs, there is still room for improvement. Artificial Intelligence (AI) will play significant role in digital libraries. It can help group related topics together, summarize text, extract knowledge from texts, find correlations between different resources, and recommend similar books or magazines based on reader preferences. Decision support systems that apply to big data are currently the closest perspective and can help users intelligently discover the content they need. For instance, journal finders enable researchers to find appropriate journals related to their article's topic for publishing their scientific papers.

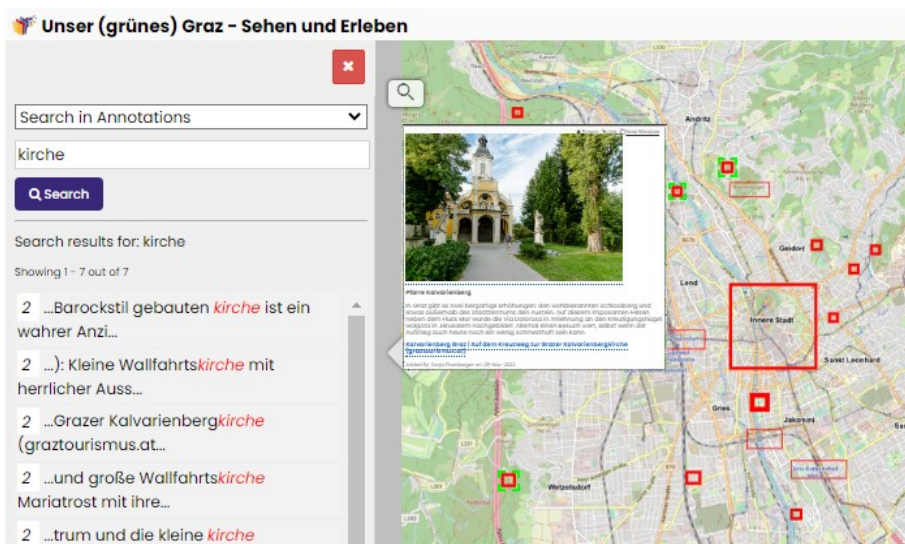


Figure 9: Tourist information: An application area for the NID system [38].

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