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The Intersecting Interaction between Web 4.0 and 5.0: An Analytical Study of Gradual Roles and the Impact of Artificial Intelligence on Evaluating User Behaviors in Higher Education Libraries in Algeria (A Proposed Model)

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Abstract

This paper aims to highlight the interactive blend between Web 4.0 and 5.0 and the interwoven, inverse incremental roles these models play in the evaluative processes and analytical studies of user behaviors toward academic library collections and various activities. It seeks to elucidate the implications and evolution of artificial intelligence software and platforms in data processing, with the goal of developing an innovative model that comprehensively addresses the diverse needs and intellectual aspirations of users. The paper endeavors to create a model that integrates Web 4.0 and 5.0 technologies, incorporating intelligent library collections and the subjective aspects of users within the framework of evaluating library services and resources. This model introduces a novel perspective on how modern software and technologies are utilized, fundamentally linked to establishing the necessary infrastructure and equipment to implement this model in the library system.

Keywords: Intelligent library collections; Digital library collections; Artificial intelligence; Web 4.0; Web 5.0.

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1. Introduction

The current world is witnessing continuous development and evolution in the most prominent and recent technologies of the World Wide Web. The emergence of the web and its generations has led to the emergence of models that have activated numerous essential features within digital arenas and spaces. Each generation of the web has played a progressively central role in the field of library and information science, shaping digital spaces, platforms, and technologies that have enhanced the efficiency of library management and information systems and their documentary chains, both in the internal environment and in serving beneficiaries and users.

Beginning with the first generation of the web, which focused on the dissemination and presentation of information and data on the internet, to the second generation, which incorporated features inspired by human communicative phenomena and their interaction with information, and progressing to the third generation, which structured, processed, and assisted electronic machines in understanding data patterns, analyzing them, and generating ideas and responses mimicking the human brain and its functioning. This evolution culminates in Web 4.0 and 5.0, which contribute to increasing the complexity of understanding smart devices, both in terms of ideas and emotions, providing an actual, interactive experience that is capable of learning, adapting, and aligning with the needs of beneficiaries and professionals in the field of information and libraries, as well as facilitating all their administrative and academic research activities.

The emergence of these technologies has resulted in a qualitative leap in the integration and overlap of the roles of librarians and information specialists regarding their use of smart information and smart library resources, harnessing the latter to serve active researchers, workers, beneficiaries, and users in the academic research field, as well as educational structures. Therefore, it has become essential to be familiar with and showcase the main technologies and the gradual, integrative roles of Web 4.0 and 5.0 in light of the growth of information needs, the evolution of information technology and its engineering, and its analysis to evaluate user behaviors in higher education libraries in Algeria, with the aim of improving the user experience and its data.

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Research Questions

Based on the aforementioned, several questions and issues related to the topic have emerged, the most prominent of which are:

1- How can artificial intelligence, in its various generations and layers, enhance and facilitate the experience of beneficiaries and workers within information systems?
2- Is it possible to provide an actual framework for the experiences of both beneficiaries and workers in the information sector in order to analyze user behaviors and develop library services?
3- What are the various roles played by generations 4.0 and 5.0 in evaluating and analyzing the behaviors, preferences, and emotions of beneficiaries within library environments?

This study will aim to present models and ideas for evaluating the human phenomenon from both the rational psychological and emotional perspectives, focusing on the interaction of users with libraries, their services, and documents.

Overview of the Web:

The world-wide web (w3) was developed to be a proof of human knowledge, which would allow collaborators in remote sites to share their ideas and all aspects of a common project. (Berners-Lee, Cailliau, Luotonen, Nielsen, & Secret, 1994, p. 76) and on the anatomy of the web "The web page is the unit of information on the web; four elements are needed for its creation, transmission, or retrieval: hypertext; uniform resource locators (URLs); hypertext transfer protocol (HTTP); and hypertext markup language (HTML)." (Pallen, 1995, p. 1552) while (World Wide Web Consortium, n.d., para. 1) has claimed that: The WorldWideWeb (W3) is a wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents. As Tim Berners-Lee wrote the first proposal for the World Wide Web in March 1989 (CERN, n.d.).

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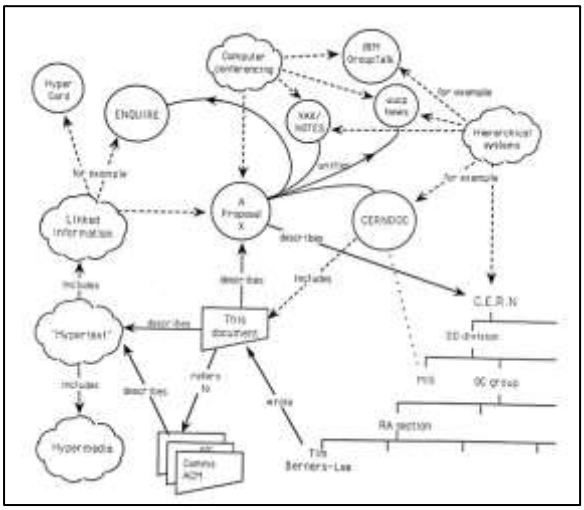


Figure 1 : *CERN. (2019). OPEN-PHO-CCC-2019-001-1*. CERN. *https://cds.cern.ch/images/OPEN-PHO-CCC-2019-001-1*

We conclude from the previous texts that efforts are directed toward creating and developing scientific paradigms aimed at making information accessible within digital web spaces. These efforts enhance methods of acquisition, availability, and provide seamless and flexible access to various types of informational resources. In this way, they overcome the spatial and temporal limitations of information containers and their physical and intellectual characteristics. Generally, the web, through its tools, software components, and digital technologies, seeks to fulfill knowledge needs and foster collaboration among specialists and researchers. Additionally, it serves as a medium for communication, interaction, sharing, research, and innovation, supported by its infrastructure, protocols, networks, servers, and platforms. This contributes to the creation of a virtual environment that mirrors the academic setting, with the aim of fostering a knowledge-driven spirit at both local and international levels.

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The Web as an Information System:

The web is considered an information system in the digital space, as it relies on a set of fundamental components, including programming languages such as HTML, CSS, and JavaScript. These languages enable the creation, processing, sharing, and dissemination of information in the virtual space in all its forms and types, automatically resembling the traditional documentation chain used in libraries and information systems and centers, as illustrated in Figure 2:

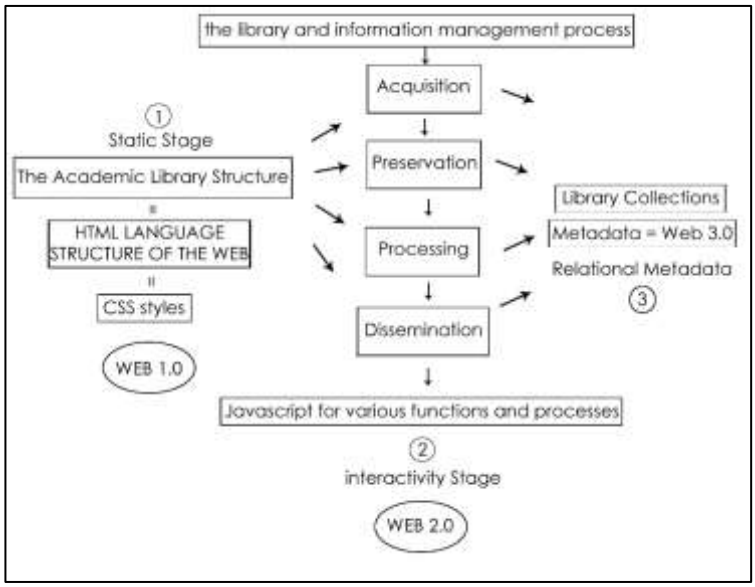


Figure 2 : CERN. (2019). OPEN-PHO-CCC-2019-001-1. CERN. *https://cds.cern.ch/images/OPEN-PHO-CCC-2019-001-1*

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Programming languages have gone through various developments in structure and design, enabling the emergence of the recognized web generations (Web 1.0 to Web 5.0). However, their primary purpose was directed toward managing information, data, and records first, and then serving the user second. Meanwhile, Web 3.0 aims to enhance how data is displayed to the user, as noted by Parvathi & Mariselvi (2017, p. 167), where the article states, 'Web 3.0 aims to regulate how content is searched and displayed by the user. This means that Web 3.0 seeks to improve the way metadata is constructed and presented to users, ensuring consistency with subject heading lists, thesauri, and all possible references. It addresses issues related to terminology used in keyword-based search approaches to enhance efficiency and build logical relationships between topics, allowing for efficient and rapid automated retrieval. Web 3.0 performs a backend role in programming languages, and the overlapping roles between information systems and web systems can be highlighted in Figure 3**:**

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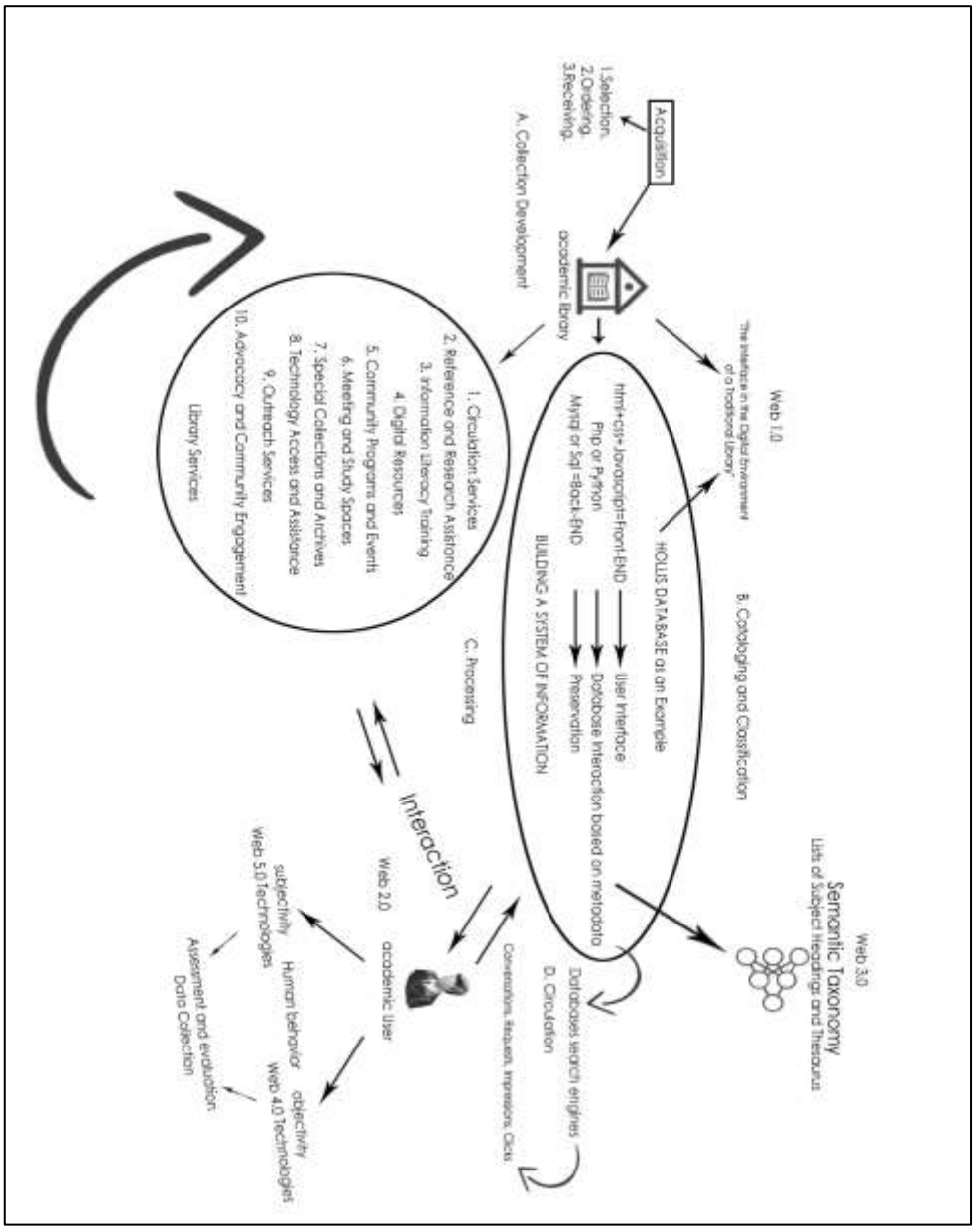


Figure 3

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1. The Web 4.0:

Definitions and opinions regarding the concept of The Web 4.0 have varied, reflecting its multiple dimensions and techniques that differ in terms of scope and objectives. However, most of the concepts published in the scientific field regarding The Web 4.0 have been addressed by various researchers. According to Almeida (2017), there is no universally accepted definition of Web 4.0, indicating a lack of consensus in the field. Nevertheless, he concluded in his research that Web 4.0 can be characterized and understood through the establishment of its systems and techniques, such as the Internet of Things, big data, artificial intelligence, and social media. Thus, we can say that The Web 4.0 is a digital paradigm that encompasses a variety of multidimensional technologies and applications within the virtual environment, relying on data and information in conjunction with smart devices, simulating human knowledge and its application to create an intelligent knowledge field that responds to human professional and scientific needs. The Web 4.0 represents the rational cognitive aspect of human phenomena and is objective in terms of information acquisition and data collection. Its emergence has also influenced information systems as structures that handle various types of knowledge. Its technologies can be utilized in reception, guidance, orientation, and inquiries regarding information containers effectively. It provides librarians with detailed evaluative services about user activities and their interaction with library resources, thereby enhancing decision-making strategies and improving and assessing library services. resources, thereby enhancing decision-making strategies and improving and assessing library services. However, the human phenomenon, as an active participant interacting with the library within the digital information space, cannot disregard the use of mental and emotional faculties derived from chemical interactions in the human brain, which play a critical role in users' decisions regarding library resources. The human brain consists of two important hemispheres: the neocortex, which activates during logical, rational decision-making regarding library services and resources, and the limbic brain, which engages during emotional thinking about specific information and data. Therefore, during evaluation cycles, it is essential to consider the human phenomenon along with its characteristics and traits. Both Web 4.0 and Web 5.0 aim for a comprehensive study of users, acknowledging their human nature, which encompasses both emotion and logical thinking.

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This makes them paradigms and models capable of simulating human knowledge relatively and fulfilling all user movements and responses to obtain the raw material for subsequent evaluation processes. The Web 4.0 symbolizes smart information, data, and resources that depend on the user and all their activities both inside and outside the library, whether related to library resources or services, representing the rational knowledge of the user. Meanwhile, Web 5.0 pertains to the emotional knowledge of the user. The Web 4.0 employs various technologies to ensure comprehensive coverage of transactions in both the internal and external environments of university libraries. This necessitates the use of smart and dynamic tools that exhibit a certain level of sophistication and sufficient analytical capability, along with virtual awareness, in order to obtain adequate information and subsequently conduct evaluations correctly according to specific criteria.

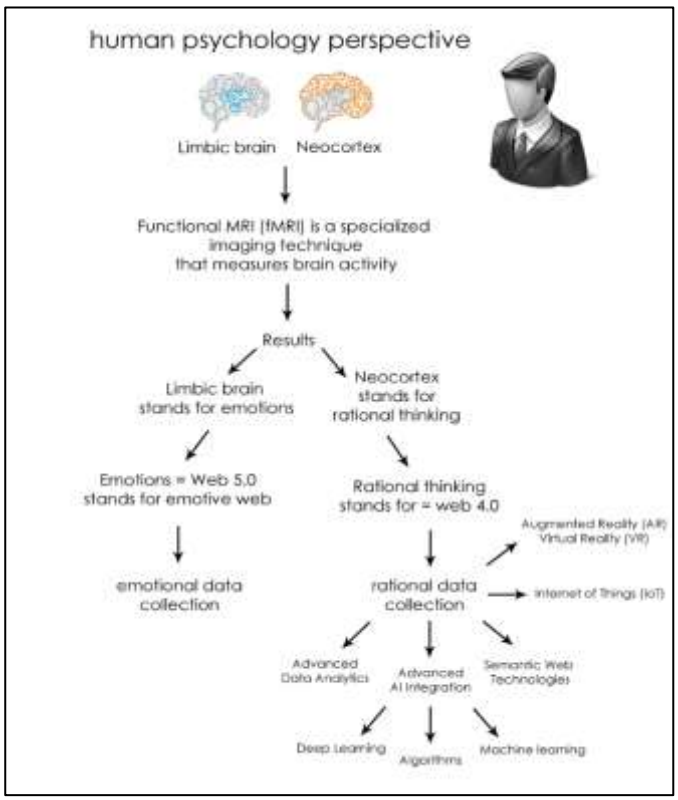


Figure 4

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It is essential to study and analyze the human phenomenon as a conscious, thinking entity that possesses a range of mental, psychological, and emotional faculties contributing to decision-making regarding library facilities and their content, both material and intellectual, as well as how users interact with them. The brain has a physiological structure that aids users in acquiring services or resources and interacting with them, ultimately leading to decisions that later serve as raw material for the evaluation process. Therefore, both Web 4.0 and Web 5.0 aim to filter, analyze, and diagnose the various inputs resulting from users' actions and messages to provide a rich environment conducive to the evaluation process, which relies primarily on the quality of data generated by users, given that the information system exists to serve the desires of a specific segment of society. However, the human being, with a complex physiological and chemical makeup, makes it challenging to predict actions and decisions.

1.2.The Web 4.0 Technologies in the Evaluation Processes of University Libraries:

The concept of Web 4.0 often refers to smart web technology; however, the technological leap that distinguishes Web 4.0 from its predecessors is the introduction of artificial intelligence technology. This technology consists of layers that work together to collect, process, diagnose, analyze, and subsequently evaluate, providing interpretations, observations, and explanations for the encoded phenomenon through a set of input data, vocabulary, terminology, and images, applying them to smart evaluation criteria. It is essential to highlight the key technologies that contributed to the emergence of artificial intelligence technology and its establishment within university library environments.

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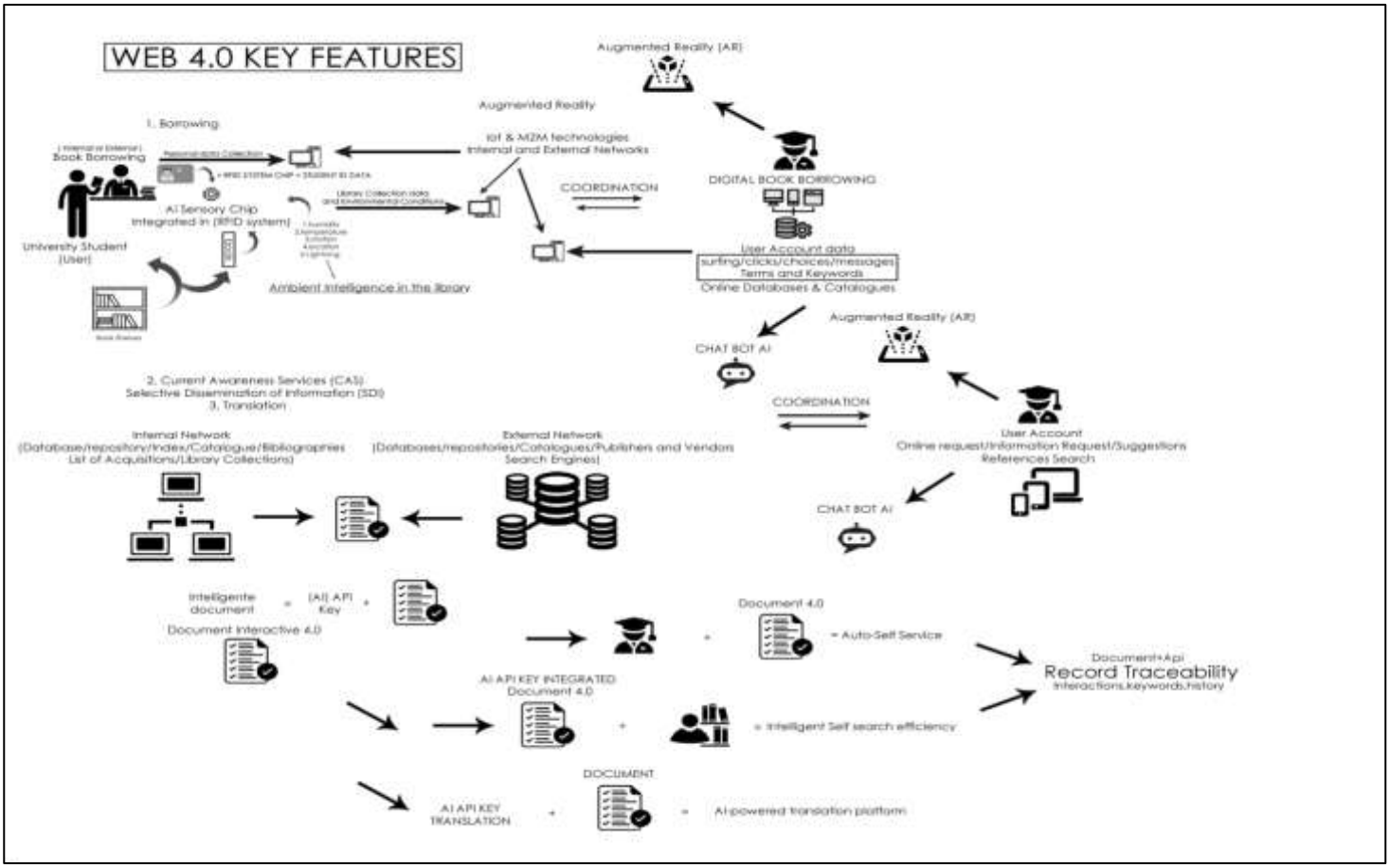


Figure 5

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2. The Web 5.0:

While Web 4.0 addresses the entirety of information, knowledge, and data to identify and evaluate the interactions of academic users, Web 5.0 establishes itself as a model aimed at analyzing the emotional experiences of individuals. Hence, Web 5.0 is known as the emotive web, reflecting the feelings and emotions expressed by users. However, this concept is still under study, as noted by Mbunge, Jiyane, & Muchemwa (2021): "Although the emotional sensing network remains a conceptual idea that has not yet been fully realized, significant progress has been made in developing prototype projects for the emotional sensing network." The idea appears promising and amenable to industrial modeling through electrical sensory sensors, similar to those employed by the human brain. Previously, Web 4.0 sought to simulate human thinking and intelligence, which result from electrical interactions among different brain regions, alongside their chemical makeup. Therefore, the concept of sensing human feelings of users, especially with the emergence of intelligent algorithms and layers of artificial intelligence capable of learning and adapting to human needs, does not seem impossible in our current era. Additionally, the success of the emotive web concept necessitates the development of more complex models and algorithms that can process all types of inputs—whether textual, image-based, or video—while analyzing contextual considerations and sensing the psychological and emotional states of users to provide a more relevant, multi-dimensional experience with the library. This is especially critical as the evaluation process and its comprehensiveness require studies of users' rational and emotional behaviors. The incorporation of these technologies into library spaces will enhance the personal experience of users' preferences within the digital library corridors.

2.2. The Web 5.0 Technologies in the Evaluation Processes of University Libraries:

Web 5.0 techniques vary for monitoring behaviors involving the feelings, emotions, and preferences of users in the library. However, it is essential to develop a model based on studying human emotions originating from the areas responsible for them, similar to the study of neural networks and their interactions, to simulate the functioning of various emotional feelings and behaviors. As noted, "The artificial neural network (ANN) is to some extent modeled on the structure of the biological brain. It consists of an

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abstracted model of interconnected neurons" (Mijwel, Esen, & Shamil, n.d.). Additionally, "Even though ANNs are the simplified version of how our brain works" (Vasileiadis, Alexandrou, Paschalidou, Chrysanthou, & Hadjichristoforou, 2024). Therefore, constructing a biological model of human emotional behavior is feasible, containing sensors capable of detecting all human inputs from an emotional perspective. This would create a conducive environment and establish a complementary relationship for an optimal evaluation process through various techniques such as:

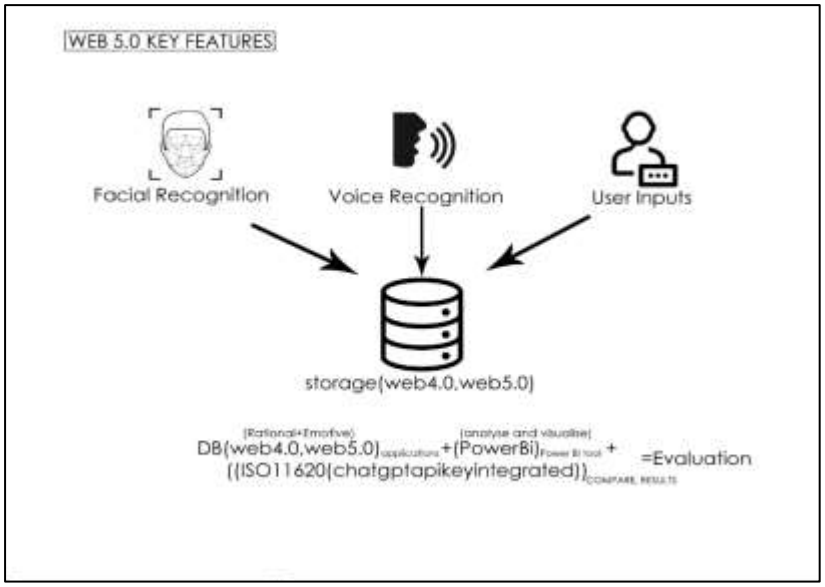


Figure 6

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Results:

The real-time evaluation process relies on various types and categories of inputs, symbols, and signals, regardless of their environment and forms, which are established in databases categorized into six types:

1.Inputs through keywords in search engines or electronic indexes.
2.Inputs via radio wave sensors recorded directly in smart documents.
3.User interaction inputs with smart documents.
4.Inputs reflecting users' utilization of library services in the digital environment.
5.Inputs from user interactions with chatbots and conversation tools.
6.Inputs from audio and video data.

The quality of data, based on the technologies employed, such as Web 4.0 and Web 5.0, is divided into three categories:

1. Inputs addressing the rational psychological aspect of the user.
2. Inputs addressing the emotional psychological aspect of the user.
3. Inputs addressing both the emotional and rational psychological aspects of the user.

However, the type of inputs can be adapted to meet the ISO 11620 standard, which includes various semantic and numerical indicators for optimal library performance. After data flow into the database and subsequent filtering through integrated artificial intelligence applications, these inputs are analyzed and classified by their entities and contexts, regardless of their nature. This process involves recalling smart documents, such as the ISO 11620 standard, which contains the key to artificial intelligence, aiding in seamless information retrieval and interaction with documents dynamically and swiftly, ultimately allowing for a comparison between database data and standard data for a comprehensive evaluation of both rational and emotional aspects. The process includes several stages, namely:

1. The data collection and information flow into databases of various types, covering both rational and emotional aspects.

2. The analysis and classification of entities and meanings in various contexts and interpretations using artificial intelligence techniques.

3. The evaluation process utilizing smart documents and interacting with them for a comprehensive understanding of the document's content, ensuring smooth comparisons.

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4. The results and subsequent decision-making.

Smart documents, which can be interacted with, queried, and discussed, have emerged recently due to advancements in artificial intelligence technology and the rise of API key units, facilitating rapid information flow, processing, employment, and extraction of all relevant details, especially when it comes to official evaluation documents. This creates an interactive evaluative environment that supports the work of information specialists. However, it is crucial to emphasize the need for developing mechanisms to understand the patterns, meanings, and terminologies of artificial intelligence technology to optimally meet the needs of librarians.

It is also noteworthy that traditional evaluation processes often require significant time and effort, as they rely on manual document collection and the cognitive ability to execute tasks according to the ideal standard requirements. This paper proposes the concept of instantaneous evaluation, which occurs rapidly, thus saving time and effort for professionals in the library and information sector. The technologies of Web 4.0 and 5.0 include various techniques that can be utilized for comprehensive service coverage and library resources, providing a data-rich model for libraries to accelerate workflow, enable real-time evaluations, and facilitate decision-making and necessary precautions based on needs.

Conclusions:

Current developments indicate the necessity of integrating, establishing, and adapting Web 4.0 and 5.0 technologies due to the time and effort they save, serving librarians or information specialists in the digital environment that has recently emerged within information systems of all kinds. It is essential to emphasize enhancing the actual technical and scientific control for all professionals in the information sector to comprehensively understand all aspects and dimensions of emerging technologies and to optimally utilize these tools in their fields.

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https://www.researchgate.net/publication/380122805_Artificial_Neural_Network_and_Its_Applications

التفاعل المتداخل بين الويب 4.0 والويب 5.0: دراسة تحليلية للأدوار التدريجية وتأثير الذكاء الاصطناعي على تقييم سلوكيات المستخدمين في مكتبات التعليم العالي في الجزائر (نموذج مقترح)

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:ملخص

يهدف هذا البحث إلى تسليط الضوء على التفاعل بين الويب 4.0 و5.0، والأدوار المتداخلة والمتعاكسة تدريجيًا التي تلعبها هذه النماذج في عمليات التقييم والدراسات التحليلية لسلوكيات المستخدمين تجاه مجموعات المكتبات الأكاديمية ومختلف الأنشطة. يسعى البحث إلى توضيح التأثيرات والتطورات التي يشهدها مجال برمجيات ومنصات الذكاء الاصطناعي في معالجة البيانات، بهدف تطوير نموذج مبتكر يستجيب بشكل شامل للاحتياجات المتنوعة والتطلعات الفكرية للمستخدمين. كما يسعى البحث إلى إنشاء نموذج يدمج تقنيات الويب 4.0 و5.0، شاملاً المجموعات المكتبية الذكية والجوانب الذاتية للمستخدمين في إطار تقييم خدمات وموارد المكتبات. يُقدم هذا النموذج منظورًا جديدًا حول كيفية استخدام البرمجيات والتقنيات الحديثة، مع التركيز على تأسيس البنية التحتية والتجهيزات اللازمة لتنفيذ هذا النموذج ضمن نظام المكتبات.

الكلمات المفتاحية: المجموعات المكتبية الذكية؛ مجموعات المكتبات الرقمية؛ الذكاء الاصطناعي؛ الويب 4.0؛ الويب 5.0.