

# Artificial Intelligence Framework for Smart Electronic Library Services Digital Transformation in Tertiary Institutions in Adamawa State

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**ABSTRACT-** This research delves to develop an artificial framework that will leverage Artificial Intelligence (AI) capabilities by creating an ecosystem of smart electronic services, fostering a digitally transformed educational environment in tertiary institution in Nigeria. The framework came up with a significant role of transformative Artificial Intelligence (AI) in reshaping digital library services. This research aimed to establish a framework that will collect, store, manage and recommends diverse datasets relevant to institutional operations and services, design an algorithm suitable for various applications that is tailored to users and institutional needs, develop an artificial intelligence framework for digital transformation of smart electronic library, train and evaluate the performance of the system for accuracy and efficiency, simulate the framing of digital paths of transformation and strategies facing disruption.

**KEYWORDS:** Machine Learning, Artificial Intelligence, Smart Electronic Library Service; Digital Transformation.

## I. INTRODUCTION

Academic libraries serve as the "heart of the tertiary institutions" by providing users with access to information and other services, such as academic staff, students, researchers, and others. In terms of information distribution, a library has long been recognized as a useful tool for users. Libraries have been significantly impacted by the rapid improvements in artificial intelligence (AI) (Subaveerapandiyar, 2023). One of the most recent digital transformations (DT) technical advancements is artificial intelligence (AI), which the university library can use to provide library customers alternative educational services. AI can support

intelligent information retrieval and sharing decisions for education and research. As AI technology development has an impact on a variety of human activities, including business, entertainment, and education; It also has an impact on how public institutions like academic libraries run. As custodians of knowledge and facilitators of learning, libraries face both unprecedented opportunities and significant challenges with the advent of AI technologies). The integration of AI in library systems represents a paradigm shift in how information is organized, accessed, and disseminated, promising enhanced efficiency, personalized user experiences, and innovative services

[3].The term "smart library" is used in a variety of settings to refer to an intellectual, digital, or virtual library. Over the past several years, it has caught the interest of numerous institutions. Nevertheless, without breakthroughs in AI technology, the idea of a smart library remains impractical. Smart libraries, as defined by Gul and Bano (2019), are combination of electronic, digital, intelligent, virtual, and network libraries. These libraries are unconditionally and totally dependent on technology and are unable to function without it in order to offer better services that are interactive, novel, educational, and practical.

[1].Using the realization of comprehensive information about the library, Zimmerman and Chang (2018), define a smart library as an integration of books and related data, as well as digital and physical resources. The management and services of libraries are made smarter and personalized by the use of huge data intelligent analytic platforms, and the demands of readers are taken into account to enhance their experience. Realizing true full data exchange and having a large-scale data-sharing facility are

prerequisites for building a smart library. However, given that this is not included in their strategic plan, the research that is currently available confirms a low acceptance rate by the tertiary institution libraries when using AI to offer creative alternative services.

[2]. Another problem is that users don't seem to be very interested in using the services that are provided. Libraries must implement technology solutions based on contemporary user interfaces, architectural designs, and conceptual frameworks and abandon antiquated solutions. In order for organizations to expand and stay competitive in the market, digital transformation is now a requirement rather than a trend. Industry 4.0, often known as the fourth industrial revolution, is the driving force behind this transition and is assisting enterprises in reaching advantages that were previously unimaginable.

In order to establish an intelligent and user-centric digital repository, the AI recommendation framework for the smart e-library in the context of digital transformation intends to combine the principles of AI, digital transformation, and library administration. In the digital age, this framework makes use of AI technology to offer improved services, better user experiences, and greater access to knowledge resources. The smart e-library itself serves as the framework's focal point. This cutting-edge digital archive goes beyond conventional libraries. It includes a wide variety of digital assets, such as texts, videos, images, datasets, and more. The e-library is made to be simple to use and accessible.

## **II. LITERATURE SURVEY**

As it is anticipated to have an impact on all sectors, digital transformation is a contemporary, developing issue that is understudied. It has varied meanings in different fields, and even within an industry it can be challenging to find a definition that is shared by all enterprises.

[4]. In order for organizations to expand and stay competitive in the market, digital transformation is now a requirement rather than a trend. At the center of this shift, the fourth industrial revolution, often known as Industry 4.0, is assisting enterprises in reaching advantages that were unimaginable just a few years ago. It is clear that Industry 4.0 enabling technologies are having a significant impact on the business sector. When properly implemented, these technologies can improve productivity and asset performance, reduce inefficiencies, lower production and maintenance costs, and increase system agility and flexibility

[5]. Utilizing rapidly evolving digital technology to address particular problems is what defines digital transformation. With organizations

now able to practically analyze the negative impact of not having embedded digital technology, it is swiftly rising to the top of the priority list for enterprises around the world. This is especially true during the COVID-19 epidemic. Before COVID-19, research on the role of Industry 4.0, which includes the enabling technologies that drive digital transformation, was active. However, the pandemic has accelerated efforts to make sure that better solutions are available to realize the full benefits of Industry 4.0. Digitalization, which is focused on the "organizational process" or "business process" of the technologically-induced transformation within industries, organizations, and markets, has largely replaced digitization, which involved converting data to digital form (Butt, 2020a).

[6]. Researchers and practitioners have been paying more and more attention to digital transformation in recent years (Hess et al., 2016). Therefore, a key component of digital transformation is the incorporation of digital technology throughout all business functions, including library systems. This necessitates a fundamental shift in how businesses operate and how they provide value to their clients and consumers. Additionally, because it typically results in a significant change in how businesses operate and how people are held

accountable for their work, digital transformation requires employee approval.

The three primary types of obstacles related to digital transformation are initiation, execution, and governance, according to Majdalawieh and Khan (2022). By overcoming these obstacles, organizations can prevent frequent failures when implementing digital transformation programs. The development of systems that prioritize innovation in establishing new models, increasing the efficiency and effectiveness of its processes, transparency, and adherence to standards requires the participation of all stakeholders. An emerging idea called a "smart campus" was made possible by opportunities created by digital transformation in higher education for smart technology research, development, and adoption in addition to their usual teaching, learning, and research roles (Polin, Yigitcanlar, Limb & Washington, 2023).

[7]. Digital innovation appears to boost an organization's performance in terms of making the processes efficient, especially with the development of software and the exponential growth of technology. The impact of digital innovation on organizations in today's world varies depending on how well an organization is prepared to employ it. According to earlier studies, higher education institutions face numerous difficulties with redundant IT systems and IT skills, with less emphasis on

digital transformation. Within academic discourse, there does not seem to be a single point of originality for digital transformation. Leavitt and Whistler's views on the possible effects of information technology (IT) infrastructure on organizational decision-making are probably the source of the procedures and technology in question.

Using technology to radically alter how a company runs and its business model, deliver new values to its consumers, and speed up business operations, digital transformation integrates digital technologies into all areas of an organization. Organizations must constantly adapt and experiment with new ideas as a result of the digital transformation of their cultures. The two primary stages of the digital transformation in an organization are digitization and digital transformation as shown in Figure 2.1.

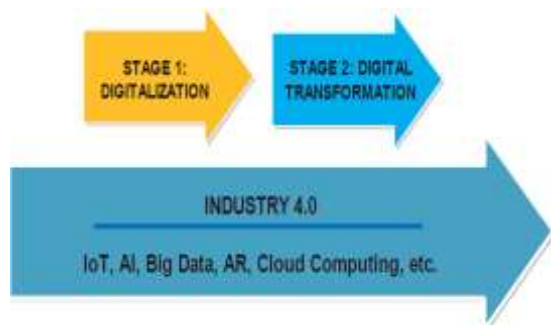


Figure 2.1: Two main stages of the digital transformation process in an organization

[8]. In the digitization stage, the organization transforms traditional systems into digital systems by, for example, upgrading the information technology infrastructure, transmission Internet lines, security, and network systems, standardizing database systems, and converting paper documents to data files and storing them in the information systems database. During the digital transformation stage, firms use digitized databases built on cutting-edge technologies to analyze, compile, and create new values. As a result, the initial phase in the DT process is digitization (Quy et al., 2023).

### Benefits of Digital Transformation

The most obvious advantages of digital transformation for an organization consist of lower operating expenses, longer-term maintained client relationships, faster and accurate decision making due to real-time provided reporting systems, and improved employee productivity. Microsoft's report has demonstrated that digital transformation contributed to 15% and 21% labour productivity growth. In general, the goals of an organization when implementing digital transformation include

improving the speed of market research, increasing competitive position in the market, driving revenue growth, increasing labour productivity, and enhancing user experience, as shown in Figure 2.2.



Figure 2.2. An illustration of the main goals of organizations

### Smart Library Management System

[9]. Smart has been used differently to represent intelligence and efficient resource utilization to meet users' needs. A smart e-library is a physical site or online platform that provides around the clock online access to digitized audio, video, and written material in the library context. It provides free copies of books, journals to authorized users. The online database of digital items is a virtual library or digital collection. A library fitted with smart library technology can be accessible without staff to library users. The technology enables library buildings to be remotely controlled, including automatic gates, lighting, self-service kiosks, and public computers. It helps expand the library opening hours substantially so that more people can sometimes use it (Aithal, 2016).

### III. METHODOLOGY

Digital transformation is a complex problem with a wide variety of facets, and it therefore requires a multidisciplinary approach. When researching complex problems, an integrated approach between qualitative and quantitative methods leads to a more holistic perspective on the problem. Implementing intelligent information services in libraries has shown particularly in light of the COVID-19 epidemic that AI-driven such as "InfoBots" or "Chatbots" may satisfy user needs around-the-clock with little to no human involvement, adjusting to the "new normal" of growing reliance on virtual spaces. AI may improve information retrieval capabilities, offer personalized services, and integrate various retrieval techniques in the context of digital libraries.

[10]. The paths of digital transformation followed most of the tertiary institution libraries do not have adequate facilities (computer and computer labs) for the students and other supporters, this has led to access restrictions to digital contents like e-books and e-journals. There is lack of technological and AI knowledge among library professionals and limited infrastructure such as multimedia assets, access to the internet subscription, access to external sources like websites for paid databases, and open-access resources among others. Every user needs different books at different time. Duplication of all physical books available in all subjects in every library is not possible for few users. Physical libraries cannot satisfy every user's requirement.

### **Area of the Study**

These include digital archives, databases and online journals, streaming media services, virtual museums and more.

### **Method of Data Collection**

The Primary Data: Primary data collection methods refer to gathering original data from individuals, organizations, or sources specifically for a research project. These methods involve researchers interacting directly with the target population or subject matter to obtain firsthand information. Primary data collection methods allow researchers to control the data collection process, customize data collection instruments to suit their research needs, and collect data tailored to their specific research questions. Examples of primary data collection methods include surveys, interviews, observations, experiments, and focus groups, etc. These methods provide researchers with the opportunity to collect data that is original, specific to their research objectives, and suited to their research design. Primary data collection is fundamental to conducting empirical research and contributes to generating new knowledge in various fields of study the primary data was collected using the following tools:

- i. External surveys or research studies: Collaborate with universities, research institutions, or external evaluators who can conduct surveys or studies on behalf of the library. These external entities can handle data collection and analysis while adhering to privacy protocols.
- ii. Collaborate with community partners: Work with community organizations or local schools to conduct joint evaluations or assessments. By gathering data together, librarians can pool resources and efforts, ensuring that privacy is respected and the workload is shared.

- iii. Online feedback forms: Create online feedback forms using free survey tools such as Google Forms or Microsoft Forms that allow participants to provide
- iv. their feedback anonymously. Ensured that the form did not require personal information and emphasize the anonymity of the responses.

Survey research approach was adopted to conduct the study. A total of 450 library and information science (LIS) researcher/information professionals and Computer science was selected randomly from all the tertiary institutions of Adamawa States in Nigeria represent the sample for the study.

### **Hidden Markov Models**

Hidden Markov Models (HMMs) are extremely common in the ML analysis of sequential data that has a dependence on time. Typically, a model will be able to explain a sequence and predict or generate new sequences. The techniques are most at home with Natural Language Processing (NLP) and with handwriting recognition, speech recognition, and biological informatics.

With an HMM there are two collections of probabilities. In the background, there is a probabilistic Markov Chain or Process as explained above. But some, or all, of the states of this Markov Process are hidden (and unseeable directly by observers). However, the hidden states 'emit' observations which can be seen or observed. These emissions of observations are themselves governed by probabilities relating them to the hidden states. An example might help with understanding the set-up. Suppose we are interested in the sequences of year-on-year climate values in New Zealand from a thousand years ago. (We may be interested in this because the climate affects the environment, its flora and fauna, and their history and development.) Suppose the years can be just hot or cold, and which they are for a particular year depends solely on whether the predecessor year is hot (or is cold). Suppose also that the probabilities of a hot year being followed by another hot year (and a cold year being followed by a cold year) are all known from modern values (which are assumed to be unchanged from those of a thousand years ago). These ancient weather sequences are Markov Processes, and their states are hidden and not directly observable.

However, the weather affects tree-ring growth, and we have modern probabilities relating that growth to the weather (which, again, are assumed to be unchanged from a thousand years ago). More than a few New Zealand Kauri trees live longer than a thousand years. So, the Kauri rings can



serve as modern emitted observations on the Hidden Markov Process of ancient weather sequences in New Zealand (Stamp 2017; Rabiner 1989).

We will not address the mathematics in detail here. But what the mathematics can do is

- i. estimate the probabilities for hidden sequence, give the observable sequence, and the other relevant probabilities
- ii. estimate the probabilities for an observable sequence, given the hidden sequence, and the other relevant probabilities,
- iii. given an observable sequence, the number of hidden model states and different types of observations, can use successive approximation on the parameters to produce values which give the greatest probability of yielding the provided sequence.

As mentioned, Natural Language Processing often uses HMMs. Mark Stamp, in his (Stamp 2017), gives a simple example of language analysis, which is more-or-less the inverse of Markov's Eugene Onegin case. Say you gave 'Marvin the Martian' (an alien) a corpus of a million words of actual English text and invited him/her/them to investigate sets of individual characters under the assumption that there was a HMM, with two hidden states, that was producing the observed English. The result of Marvin's research would be that there were two relevant sets of letters, and they would be the vowels and the consonants. Initially, Marvin knows nothing about English, yet Marvin can learn structural and statistical properties using an HMM.

#### IV. CONCLUSION

Sequel to the research made throughout this work, I believe that the use of artificial intelligence in library management creates innovation and optimization, fostering a digitally transformed educational environment in tertiary institution significantly enhancing user experiences while improving operational efficiency. Artificial intelligence is built with several capabilities and opportunities transforming traditional library services, from intelligent search algorithms to personalized recommendations. AI in libraries has the fundamental ability to adapt and evolve in response to user needs and technological advancements. The implementation of virtual assistants and chatbots has enhanced user support, providing immediate and personalized assistance to users navigating the vast areas of information efficiently. It has been observed that artificial intelligence is an essential tool for digital transformation of smart electronic library. Evaluation and proper planning will further reduce

the time cost of acquiring library resources and databases. The use of artificial intelligence in library will enhance a wide value of knowledge and exposure to essential resources limited by cost and boundary.

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