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Viable Future of the Libraries Ahead: A Shift towards Tech Singularity

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Abstract

The present paper intends to envisage that libraries might be operated as superhuman machine intelligence after symbiotic era (about 30 years i.e. 2020-2050) and resulting a push towards libraries of technological singularity. As technological invention quickly converts the mode of access to information resources are progressively available online and in digital formats. The need for electronic information services to the users' community are also accelerating over time at an exponential rate. In the digital era, libraries are hub of information accessible to people of the every corner of the world. Rapid progress of technology has an unbelievable impact on libraries and information centres. Format and mode of access have been changed with the generation of new information using newly emerging technology. In the long journey of evolution, libraries have already been passed over several eras starting from the agrarian society (7 thousand years ago) to information age. To look forward the viable future of the libraries ahead, this paper attempts to find the conjectural turning point in ensuing era when there will be an uncontrollable technological advancement in the prevailing dynamic hub of information landscape. The impact of web based teaching and learning platform has a great effect on every aspect of library and information centres as well as catering new services, scopes and challenges to the library professionals for participation in the repositories of symbiotic age including virtual reality, augmented reality, web based digital services etc. With an overview of the technological singularity in the future world, this paper presents the prospective benefits of emerging tech innovations and their ethical implications on libraries. Singularity implies a fast growing technolical progress when human history as people have known it ends and a curious new era begins. Libraries might become smarter than human after machine.

Keyword(s): Symbiotic, Singularity, Superintelligency, Libraries, Implications

Abbreviation(s): IT (Information Technology), AI (Artificial Intelligence), ASI (Artificial Super Intelligence)

Introduction

In the IT era, libraries are hub of information accessible to people of the every corner of the world. Rapid progress of technology has an unbelievable impact on libraries and information centres. Libraries pave the way of a sustainable hypothetical future. Format and mode of access have been changed with the generation of new information using newly emerging technology. In the long journey of evolution, libraries have already been passed over several eras starting from the agrarian society (7 thousand years ago) to information age. To look forward the viable future of the libraries ahead, this paper attempts to find the conjectural turning point in ensuing era when there will be an uncontrollabe technological advancement in the prevailing dynamic hub of information landscape. As technological invention quickly converts the mode of access to information resources are progressively available online and in digital formats. The need for electronic information services to the users' community are also accelerating over time at an exponential rate. The impact of web based teaching and learning platform has a great effect on every aspect of library and information centres and catering new services, scopes and challenges to the library professionals for participation in the repositories of digital era including virtual reality, augmented reality, web based digital services etc. With an overview of the technological singularity in the future world, this paper presents the prospective benefits of emerging tech innovations and their ethical implications on libraries. Tech Singularity or merely the term 'singularity' implies an ever-increasing technolical progress when human history as people have known it ends and a curious new era begins. In the singularity age, libraries might become smarter than human and artificial intelligence might play a pivotal role transcending human-level performance. The present paper intends to envisage that libraries in foreseeable future might be operated as superhuman machine intelligence after symbiotic era (about 30 years i.e. early twenty first century-mid twenty first century) and resulting a push towards libraries of technological singularity. Digital transformation offers library opportunities to render more efficient and effective services to its global users and at the same time library leads towards open access to knowledge gateway to a greater extent. Digitisation of library collections makes it possible to enhance rapid access to, and transmission of information resources, which will uphold a topic of the vision of foreseeable library in automation age ahead when machine intelligence will surpass humans and is expected to behave unpredictably.

Objectives

The main objectives of the this work are to

i) to hunt the transforming vision and changing role of future library to satisfy the varied requirements in the machine learning platform;
ii) to describe the hypothetical future where technological advancement is irreversible and out of control and to define cyber or tech singularity which will radically and unpredictably replace human activities and reality as well;
iii) to discuss the features of an imagining intelligent library (Library 4.0) that can analyse huge amounts of data and is distinguished by its capability to manipulate big data and

iv) to speculate the role of librarians in the ever changing situation.

Literature Review

Much have been created by a great many authors energize library and information professionals to envision beyond the uncertain future. In 2011, Steele[1] speculates the idea of realising about unpredictable future by imagining the 'singularity' which might be used for after machines become smarter than humans and artificial intelligence might transcend human intelligence.

Bhakar[2] in his paper focuses the transformative journey of libraries through ICT and AI integration. As he opines that libraries are ready to accept symbiotic technology with tradition, coordinating their essentiality, connection and pertinence in community's knowledge hub. Libraries presume an affective role in the digital platform, complying with the digital transformation while bearing steadfast to the vision of library.

Hussain[3] points out the challenges confronted by the library in the era of industrial revolution in present-day IT enhanced environment. He shows how the fourth industrial revolution makes an enormous change in the lifestyle of common people as well as many aspects have been affected by the Industry 4.0. Libraries are not an exception. As users are interconnecting to each other at huge momentum, data analytics, machine learning and deep learning, artificial intelligence and automation of every aspect have turned to a need of the hour. With an overview of the technological singularity in the future world, this paper gives an idea of their ethical implications on libraries and the prospective benefits of emerging tech innovations.

What is Tech Singularity?

The technological singularity (also called tech singularity or merely singularity) implies "the idea that there could come a point of such extraordinary growth in the sophistication of technology that there's a transformation". The terms denote a theoretical future event in human history generated by the ever-increasing acumen of new technology to accelerate the rate at which new technology is developed. In other words, the idea of tech singularity is a hypothesized turning point in ensuing era when there will be an uncontrollabe technological advancement in the prevailing dynamic hub of information landscape.

Libraries in the era of Web Technology

Navigating the relationship between human and machine in the digital age is a challenge that requires careful insights across developmental cycle of libraries starting from agrarian society to information age. Evolution of rock engravings, cave inscriptions, languages, scripts, printing technology and electronic devices slowly improved information storage and its dissemination within the community and consequently growth of social skill and enlightment. Carving on rocks and sculptures were first information sources in the primitive age. Inscriptions on wall, cave, bark leaves, leathers, metals, clay tablets were the then information medias that were stored carefully as antiques of a library at one place. With the advent of printing technology, human civilization seized proficiency for printing the books. Gradually, librarianship emerged as a information science discipline through nineteenth century. Access to web online resources kept down on-site visits to the libraries, however importance of library resources online and offline are continued. Progress of information and digital technologies and extensive use of resources available on clouds sets libraries to use client-server architecture.

Computer-mediated digital communication made it possible to store the information globally on distributed computing or cloud based computing. Presently, a new term “information age” (about 70 years i.e. from mid twentieth century to early twenty-first century) was used to represent the position of a social sector of the community. This information age is also called “the new media age” or “the digital age” as information is now accessible collectively to all sections of the society at the remote places.

Invention of transistor and integrated circuit paved the way of advanced digital computer.

Periods	Inventions
1950-1960	Transistor, Integrated Cicuit, Large Scale Integrated Circuit, ANN
1961-1970	Microprocessor, Computer, Audio Cassette
1971-1980	E-mail, Digital Camera
1981-1990	Personal Computers, Compact Disc, Microsoft Windows, Internet
1991-2000	World Wide Web, Linux, DVD, Text Messaging, Java & JavaScript, Google: the first web browser, USB flash drives, Bluetooth Device, Web 1.0 (The Hypertext Web), Wi-Fi
2001-2010	iPod, Skype, Voice over Internet Protocol (VoIP), Web 2.0 (The Social Web), Library 2.0, iPhone, Kindle, Android, YouTube, Facebook, Twitter, 4G Network, RSS Feeds, Google App Engine/Serverless Computing
2011-2020	Web 3.0 (The Semantic Web), 3D Printing, Artificial Intelligence, Duelling Neural Networks, Internet of Things (IoT), 5G, Library 4.0, Blockchain, Google Glass, The Cloud Architecture, Virtual Reality (VR), Augmented Reality (AR), Drone Delivery, Quantum Computing, Machine Learning Cybersecurity, MOOCs.

Web 1.0

The document/information oriendted version of World Wide Web (WWW) was first emerged in 1989/90 as “read-only” web which is popularly known as web 1.0. This is the first generation of World Wide Web is defined as web of information connections. The main characteristic of Web 1.0 includes:

- The core web protocols are Hypertext Transfer Protocol (HTTP), Hypertext Mark-up Language (HTML) and Uniform Resource Identifiers (URI);
- It includes static web pages;
- It uses basic HTML;
- It ensures online information read-only content accessible by users at any time.

Web 2.0

The second generation of web was defined by Dale Dougherty in 2004 as social media web or read-write web. Its features include:

- It emphasizes creator/user-generated content, interoperability and participatory social interactions for end users;
- It ensures relationship technologies emerging with virtual community based input sharing with the help of blogs, podcasts, wikis, RSS feeds and cloud computing;
- Web 2.0 supports web application that facilitates collaborative content generation, updation, web design, modification and group intelligence or collective wisdom which is shared knowledge and decison process arrived by individuals and groups;
- Web 2.0 features a platform or software having multi-device capability.

Web 3.0

In 2006, the third generation of web i.e. Web 3.0 was coined by John Markoff and this web was introduced as a “semantic web”. The Semantic Web is a system that enables computers to understand and interact with the complex human requests where the relevant information sources should be semantically structured. The main features of Web 3.0 are:

- Web 3.0 supports a web oriented structure and world wide database;
- It interacts with the users' queries based on the meaning;
- It works with Resource Description and Framework (RDF) Schema, static HTML documents and inference languages that determines an intended texts from a literal meaning;
- Supports SaaS architecture which implies vendor hosts an application on a remote server ;
- Web 3.0 is executable or intelligent web that includes AI, 3D and web learning;
- It is a distributed database and is capable to perform tasks on multi-user virtual environment;
- Provider's machine resources are pooled to serve multiple users using a multi-tenant model which is also called resource pooling.
- It ensures website personalization that implies the process of creating unique, customized experience for each web visitors.

Web 4.0

Web 4.0 represents the “symbiotic web” for the next step in the web technology. The interaction between humans and machines transforms WWW with Web 4.0 and they become symbiotic. The present era of the symbiotic age (about 30 years i.e. from early twenty-first century to mid twenty-first century) leads to the development of Web 4.0 which creates a symbiotic relationships between humans and machines. Web 4.0 is also called ubiquitous web or intelligent web as it connects the Internet of Things (IoT) and Virtual Reality (VR) and Augmented Reality using controlled interfaces and it replaces real life environment. The impulse behind the symbiotic web is omnipresence of people and robots in symbiosis. Main characteristics of the fourth generation of web i.e.Web 4.0 include:

- Enhanced user interaction and collaboration;

- Its features include increased seamless integration between physical and virtual worlds;
- In Web 4.0 machines will be capable of learning from user interactions and will perform critical problem-solving tasks alongwith the decision-making process;
- It is highly personalised and ensures context aware access;
- Advanced security systems i.e. machine learning cyber security;
- Self-service technology

Internet of Things (IoT)

The term 'Internet of Things' was coined in 1999 by the British technology pioneer Kevin Ashton. IoT is an internet-like structure which connects everyday physical objects embedded with sensors, softwares, Radio Frequency Identification (RFID) chips or similar tags. It may be referred to the collective network of interlinked devices that connect and exchange data with other IoT devices and cloud. IoT tracking systems and its softwares allow libraries first to locate information resources (books and other medias) particularly when a reader orders a book and then the system sends a robot to the specific stack to supply the book elsewhere.

Virtual Reality (VR)

Virtual Reality implies a computer technology that simulates three-dimensional images or real having an imagined environment so that the community people can interact with it as if physically present. Sometimes, it refers to “real reality” that is the reality, the real world, which is not virtual nor augmented nor an online world. VR supported visual retrieval application in information retrieval, can actualize speedy integration of resources, and also offer a swift search of relevant literature content. It also ensures the efficiency of retrieval by providing information users with a satisfactory retrieval service model.

Augmented Reality (AR)

Augmented Reality is the computer process of merging of a view of the real-world environment upon a digital image in real time. AR enhances both the virtual and real world while VR only enhances a imaginary reality. AR can be accessed with a smart phone and controlled by its users whereas VR users are controlled by the systems. Augmented reality can host a virtual environment where students from virtual reading circle can perform group assignment and learn from each other in a virtual enhanced learning platform. It can also host a virtual book library or study centre where users can carry on their discussions, forums etc. in virtual mode.

Flipped learning

Flipped Learning is a system of learning in which pursuants learn new material by watching video lectures outside the classroom and what used to be homework is done in guided classes instead. With the flipped learning model, pupils can access to the primary learning materials independently, at home, often via video lectures, online tutorials etc. This motivates them to encourage used to the ongoing process of self-study and at the same time helps them to learn at a convenient time.

Experiential learning

Experiential Learning is a process of learning through hands-on activity and observation as in role playing. Experiential Learning can be defined as "learning through reflection on doing". Learners learn through experiences by discovering, doing, applying and reflecting. These help them to develop self-reliance and communication skills. Experiential learning assists to gain decision-making skills by solving real world problems.

Blockchain technology

The first shared blockchain was envisaged by a group of persons or person known as Satoshi Nakamoto in 2008. Blockchain is a shared record of past transactions across the network of computers participating in the technology. It is difficult for the system to be altered or hacked data stored in the blocks linked together to form a chain. The purpose of blockchain is to authorize digital data to be distributed but not modified. Blockchain is an emerging technology that can improve collection management, collaboration among researchers and privacy of their research data as well by ensuring reliability, preservation and security.

Digital Content Library

With the advent of enhanced IT environment, it rises the gradual use of content creation, digital content library or a content creator space for producing and sharing web contents in digital platforms. Content creation is process of creating social media (interactive forms of media that allows users to interact with each other generally by means of internet) content in digital context. By generating and sharing learning contents such as instructional images, audio files, tutorials, lecture-videos, assignments, librarians or information professionals could reach a group of users of libraries to suit the specific needs of them.

Context-aware Library

A library can be defined as a context aware if it uses context to provide relevant services to the users to get information about its context at any given time and to suit its operations in accord with its services. It provides services like context-aware computing which is a mobile technology which applications can discover and take advantage of situational information (such as user location-based information, context-aware access or logging in, authentication, etc.).

Libraries in the symbiotic age

Libraries will have to deal with wide-ranging synchronous big data. Libraries in the symbiotic age are expected to be in keeping with intelligent machines using tools of Web 4.0 to interact with human queries. The Internet of Things would be more interactive with each other. Future libraries should have many interactions between man and machines using various AI powered research tools and data analytics. Context-aware access, AI based ANN and machine learning that can classify user queries and information embedded in texts, precised information retrieval systems, semantic web technologies etc. will play considerable roles in library and information services. Information professionals need to be more interactive.

Libraries after the Symbiotic Age: a journey towards the 'singularity'

Libraries deserve to continue to upgrade along with the onward movement being experienced with Web 4.0 and thereafter emotive web i.e. Web 5.0. In the age of machine autonomy (about 10 years i.e. 2050-2060), there will be a smart execution of all library routine works including automation of document identification and delivery process. Here autonomy means “a minimal engineering sense of functional autonomy, which refers to a system’s capacity to operate independently, without external agents’ control” (Laitinen and Sahlgren, 2021). In the era of tech singularity, libraries will depend on technological innovations and human progress as their regulatory components. The library can be said to be a library that is convergence of virtual and physical world. With the advancement of technology, AI is becoming smarter than human everyday as a set process of new algorithms come up. The future vision of libraries that are user-centric, fully digitized and intelligent. Future library is a hub of technologies like the Internet of Things, big data analytics and artificial intelligence to customize patron needs, experiences and enhance community participation. Future libraries activities will be controlled by machines are much faster than humans and those intelligent libraries will eventually surpass that of humans. The main feature of the sustainable libraries ahead will supposed to have machine learning algorithms, deep learning approach and they will respond to human interactions as well as to disclose its own reactions in a natural way. Text search usually covers the different languages of the users' community. They are of various forms like images, audios, and videos search are now at work. Nevertheless, coming era search mechanism will include the expertise to search for such facets as density, mass, volume, speed, opacity, tone, taste, smell, texture. Computers will perform added humanlike activities and will replace human brain with some new traits that will convey us the sense of being in a room with other humans. As we attain the skill to carry out increasingly sophisticated searches, the role of the librarian to facilitate in discovering this sort of queries also comes to be more and more significant. Future library will become a cultural hub of information resources to support the things considered as an indispensable. The specialised knowledge of AI expert system and machine learning algorithm has been applied in libraries and information centres to work with the future innovative technologies and to experiment with creative spaces. These creative spaces may have some future uses like imagination room, recording studios, virtual meeting rooms, ateliers or art studios, audio and video editing studios, tele-presence rooms, blogger and podcasting stations, mini theaters etc. There are some AI tools which are being used not only in the field of LIS but in many spheres of life and fields of study to solve critical problems.

Machine Learning is a field of study associated with the development and design of algorithms and techniques that allow computers to learn. Machine Learning is the artificial intelligence technology which is the ability of machines to learn without being explicitly programmed. ML is meant for well-defined tasks with structured and labeled data. Examples include chatbots, pattern recognition, big data, text data mining and robotics.

Deep Learning is a subset of machine learning based on the interpretation of the structure of data that uses deep neural networks to simulate the critical decision-making ability of the human brain. Deep learning is meant for complicated tasks that require machines to make sense of unstructured data. The AI tools that are mainly used in the context of deep learning are artificial neural network (ANN), natural language processing (NLP) and image processing.

Pattern Recognition is a data analysis technique that uses machine learning algorithms to automatically recognize patterns and consistencies in dataset. The pattern recognition method is used for the imaging, interpretation and discovery familiar patterns of data quickly and accurately. Examples include face detection, computerized test or captcha and fingerprint analysis.

Neural Network is a real or virtual computer system designed to imitate the brain in its ability to learn to assess imprecise data. The neural networks consist of interconnected nodes (connection points among network devices i.e. parts of the larger networks) that process and learn from data, enabling tasks such as image classification, perception, autonomous driving, speech-to-text transcription.

Natural Language Processing (NLP) is an interdisciplinary subfield of computer science and information retrieval concerned with the interactions between computers and natural (human) lanugages. NLP is specially a processing of huge amounts of natural language data. NLP is a type of computational analysis that is also a part of AI, for example, e-mail spam filtering, document summarization, machine translation, etc.

Drone Book Delivery

To make accessing resources easier, libraries are now giving delivery direct to our rooms by drone. The drones make reaching remote places easier by simply choosing the items a user needs to have from library catalogue, first he should select the 'Request' and then click 'Drone' from the list of options. Users may click his/her location on the map that appears.

Artificial Superintelligency is the intelligence surpassing the level of a human genius. It is also called hyperintelligence. Superintelligence systems are high-functioning systems that emulate and even transcend human intelligence but only for a specific purpose. ASI is also known as super AI or superintelligent AI. The newly evolved digital assistants, powered by natural language processing and machine learning, can assist library users discover the sophisticated retrieval system, interact queries, and even offer AI powered services like real-time language translation service. These include the AI services like analysing users' reading experiences and preferences, personalized search recommendations. This can help library users navigate new journal-articles, books and authors they might be fond of, inculcating their reading habits.

Will ASI replace the role of Librarians?

To effectively serve library users in the era of autonomy, the librarians must furnish themselves with analytical skills and sphisticated technological acumen. In this era, the industry 4.0 will require artificial superintelligency-based architectural platforms and modern time developments, distinct from conventional human prioritized framework. They encourage implementing AI powered automation systems in libraries to make proper use of library resources among the users. As a librarian, it is necessary to stay informed about the evolving role of artificial intelligence in libraries. Librarians should provide clear guidelines on AI adoption to the ethical implications and the importance of enhancing media literacy skills among library staff. They need to join in forums, conferences, seminars, discussions, workshops & training, and be ready to cope up with the difficulties of integrating AI systems aptly in library surroundings. Librarians must adopt skills in providing information resources in the community and ensures everyone has access to information. In the context of AI trends & opportunities in libraries, the AI librarian has to perform a specialized role that blends traditional librarianship with proficiency in artificial intelligence (AI) and digital tools & technologies. They are responsible for utilizing AI tools and digital learning resources to keep on updation, processing, information access and dissemination in a library setting. Although Artificial Intelligence has the potentiality to remodel library and information services, it is unlikely to replace librarians entirely. Librarians' distinctive skills, such as critical thinking, empathy, personalized or referral service cannot be replicated by AI. AI can become a complementary mechanism to librarians' artistry or creativity rather than replace it. Librarians' expertise will coexist with the AI opportunities. It can be said that technology is used to supplement rather than replace human services.

Ethical Implications of AI in Library and Information Systems

Solutions made by AI technologies may give rise to ethical issues regarding reliability, transparency, data authority and control, authenticity and the ethical use of AI in decision-making. Ensuring transparency in intelligent systems application is really a challenge that libraries and information centres must address. Libraries must plan and control the ethical implications of making use of AI tools and techniques that could be biased against certain user groups (Diakopoulos, 2016). One of the notable ethical considerations for AI implication is that the technological knowhow is fair and equitable. Using artificial intelligence may cause data privacy to put in danger. AI technologies can have unexpected outcomes that may cause inconvenience to the individuals or groups. Hence, it is very much required to think about human rights while using AI algorithms. Libraries and information centres must setup a plan to align with the ethical values:

- Ensure to prevent bias based on factors like socio-economic status, gender and race.
- Ensure that AI systems must maintain the data privacy.
- Use of AI systems should be legitimate.

- Libraries must think about human rights when implementing AI systems.
- Social consequences of AI should be taken into consideration.

Findings

The salient findings are:

i) AI tools (ChatGPT, ChatPDF, Scholarcy, Elicit, Researchrabbit, Scite, Openread etc.) are making information resources easily accessible and establishing links between researchers who share related academic interests, interdisciplinary coordination and a suitable framework for smart interaction between users and machines.

ii) AI enormously helps to contribute to sustainability of libraries by reducing operational costs and increasing knowlege expertise.

iii) AI enables advance search features making it more easier to find information quickly.

iv) NLP can be applied to disseminate more accurate and context-aware results by analyzing user queries.

v) AI system-supported libraries are enable to store and fetch books from far-off repository and it is also possible to decrease the amount of storage space used by book-racks, bound volume journals & newspapers and other collections of a library.

vi) AI powered future library services are expected to help immensely in content recommendation by providing users' reading patterns and preferences to cater tailored suggestions. It may help researchers to discover new information related with their subject of interests.

vii) Using AI-powered virtual web assistants or digital assistants like voice-controlled assistants can enhance user interaction. Users' community may have a genuine user-friendly involvement by verbally interacting information, renewing documents, or alerting notifications.

viii) Future libraries will become a suitable platform of data analysis for research support working with large scale of data, representing trends and outlining conclusions.

Conclusion

In current situation library professionals must be conscious about the survive and strongly enabled for the future tech singularity library. Expertise in implementing well-equipped technologies in the coming symbiotic and autonomy era, for example, front-end & back-end cloud computing architecture, superhuman machine intelligence, big data analytics, electrinic resource and digital library management reveals those information professionals' expertise and enthusiasm. The central points of attention of the foreseeable sustainable libraries in the tech singularity era are: uncontrollabe technological advancement by transcending human-level performance, context-aware access, machine learning, user interface and community interaction, environmentally conscious green library architecture, expertise and skill. It may be concluded that artificial intelligence will eventually surpass human intelligence, in the process gaining self-awareness and then assume control. AI is evolving at an ever accelerating rate and can already perform brilliant jobs so superintelligent or hyperintelligent AI will come to light momentarily this day. AI is being used extensively in the field of library and informations science also. Super intelligent robot will control the future library activities operated by the ever-increasing ability of sophisticated technology to speed up the rate at which new better equipped library is developed and thus forthcoming library will become a smarter than machine in the technological singularity era.

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