A STUDY ON ARTIFICIAL INTELLIGENCE AND ITS APPLICATIONS IN ACADEMIC LIBRARIES

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***Abstract*- AI is one of the important areas of computer/data science allowing a machine to perform tasks in a way similar to a human performing them. Its main goal is to give machines the ability to process information and make decisions based on that information, in the same ways humans do. However, the science and the industry of AI are far from being fully explored and developed. AI is becoming increasingly prevalent in many applications; it is not going to completely replace human operators. In the long run, AI is expected to enhance human abilities and be the dominant technology of future libraries.**

***Index Terms*- Information Technology, Hardware, Library Automation Technology, Artificial Intelligence, Expert System, Natural Language Processing, Pattern Recognition and Robotics**

I. INTRODUCTION

The first industrial revolution attempted to create machines that could replace man's physical power. Industrialization has transformed the society totally and brought immediate crises in later development. In fact there are machines that can outperform human beings over the centuries man's working ability and thinking process have seen a sea change. The society is becoming increasingly centred on information handling, processing, storage and dissemination, using microelectronic based technologies, today's computers can stimulate many human capabilities such as reading, grasping, calculating, speaking, remembering, comparing numbers, drawing, making judgments, and even interactive learning. Researchers are working to expand these capabilities and, therefore the power of computers by developing hardware and software that can initiate intelligent human behaviour. For example, researchers are working on the systems that have the ability to reason, to learn or accumulate knowledge to strive for self-improvement, and to stimulate human sensory and mechanical capabilities. Experts are convinced that it is now only a matter of time; the present generation will experience the impact and utility of new applications based on artificial intelligence in offices, factories, libraries and homes. This general area of research is known as 'Artificial Intelligence.

II. DEFINITIONS OF ARTIFICIAL INTELLIGENCE

1. John McCarthy: Artificial intelligence is "the science and engineering of making intelligent machines, especially intelligent computer programs". In other words, AI can be defined as "a branch of computer science by which we create intelligent machines which can think like humans, act like humans, and able to make decisions like humans."
2. Bellman: "The automation of activities that we associate with human thinking, activities such as decision making, problem-solving, learning."

AI is composed of two words, "artificial" and "intelligence," where "artificial" stands for "human created' and "intelligence" stands for "thinking power." In other words, AI is "a man-made object with thinking power'.

III. TYPES OF AI

AI can be classified into six types depending on the performance of machines (https://www.javatpoint. com): reactive machines, limited memory machines, theory of mind, self-aware, ANI, AGI, and ASI, as briefly explained below (Rouse, 2020).

3.1. Reactive machines: Reactive machines are conventional types of AIs that possess only limited capability to simulate the ability of the human mind. Reactive machines work without memory-based functionality, so they cannot correct their present actions based on their past experiences. Therefore, these machines are not capable of "learning." They study the surroundings and select the best solution among the possible ones. A well-known example is Deep Blue, the IBM chess program that defeated Garry Kasparov in the 1990s (Joshi, 2020).

3.2. Limited memory: As is clear from the name, these AI systems have a small amount of memory, and thus very limited capacity to apply past experiences to new decisions. This group includes, among others, chat bots, virtual assistants, and self-driving vehicles. Many existing applications fall under this category of AI.

3. 3. Theory of mind: This is a psychological term. Theory of mind is the future AI systems that are presently planned to be developed (Tucci, 2020). When applied to AI, these systems are expected to have the social intelligence to understand emotions.

3. 4. Artificial Narrow Intelligence (ANI): The ANI is also known as Weak AI, that is, the one designed and trained to undertake only one particular type of work (Rouse, 2020). This definition includes all the existing AIs, including the most complicated ones. Any AI that utilizes ML and DL to teach itself may be called an ANI. Since the ANI performs only a specific task autonomously due to its programming limitations, it has a very limited or narrow set of competencies.

3.5. Artificial General Intelligence (AGI): The AGI is also known as Strong AI. Its program can replicate the cognitive abilities of the human brain. It can perform a variety of tasks, as well as learn and improve itself. It is a self-teaching system that can outperform humans in a large number of disciplines. It provides the ability to perceive, understand, learn, and function as humans do

3. 6. Artificial Super Intelligence (ASI): The ASI will probably be the future AI research area, as it would be the most capable intelligence in the world. The ASI will not only replicate the intelligence of human beings but also have much higher storage (i.e., memory), faster data analysis, and better decision-making powers. The capabilities of ASI are expected to supersede that of humans. The AGI and ASI are expected to create a big revolution in the future, but they also may threaten our way of life. An example of ASI includes the Alpha 2, which is the first humanoid ASI Robot (Rouse, 2020).

Although artificial intelligence is a young discipline, it makes society beyond imagination.

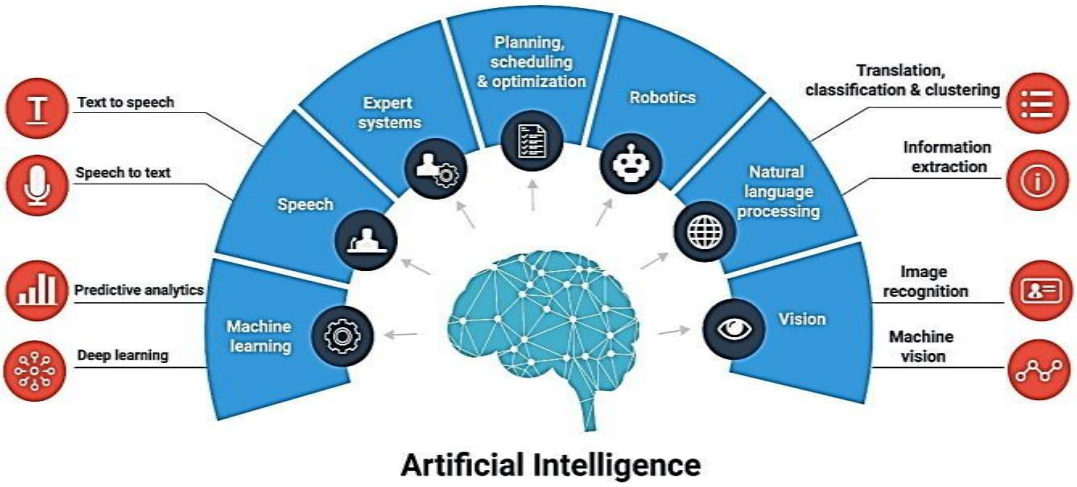

Figure 1. Pictorial diagram of AI Components

AI sub-areas, namely expert systems, natural language processing, pattern recognition and robotics, aim to simulate human intelligence with computers. Some recent computing techniques and areas for artificial intelligence development discussed below:

a) Expert System: Expert System are the knowledge based computerized systems which play a role of intelligence interface or gateway for providing access to database and to obtain relevant information. They range in scale from simple rule-based systems with flat data to very large scale, integrated developments taking many person, years to develop. An expert system is a computer program that provides expert advice, decisions or recommended solutions for a given situation.(Wikipedia/expertsystem,2014) The different components of expert systems are: Knowledge base, Inference Engine, and User Interface.

b) Natural Language Processing: One of the long standing goals of computer science is to teach computers to understand the language we speak. The Ultimate generation of computer language is the Natural language. Artificial Intelligence scientists have succeeded in building Natural language interface to a large extent using limited vocabulary and syntax. Natural Language Processing allows a computer to understand the main linguistic concepts within a question or solution. Its goal is to design and build computer that analyze, understand and generate language that human use naturally.(Kumar,2004) The different components of natural language processing are, speech synthesis, speech recognition, machine translation, linguistic approaches, information retrieval and information extraction,

c) Pattern Recognition: It is the process of establishing a close match between some new stimulus and previously

stored stimulus patterns. This process is being performed continually through the lives of all living things. Pattern recognition is studied in many fields, including psychology, ethology, cognitive science and computer science. Pattern recognition is based on either a priori knowledge or on statistical information extracted from the patterns. The patterns to be classified are usually groups of measurements or observations, defining points in an appropriate multi dimensional space.(Wiki,2014) The components of pattern recognition are; data acquisition, pre-processing, feature extraction, model selection and training, and evaluation.

IV. ARTIFICIAL INTELLIGENCE AND ITS APPLICATIONS IN LIBRARIES

Computers provide the perfect medium for the experimentation and application of Artificial Intelligence technology in the present era. AI has more success at intellectual tasks such as computer based game playing and theorem proving than perceptual tasks. Sometimes these computer programs are intended to stimulate human behaviour and they are built for technological applications also such as Computer aided instruction (CAI).In many cases the main goal is to find any technique that does the task quick in the better way.

4.1 Application of Expert System in Library Activities:

Library activities related to the reading materials, users and staff. The application of Expert Systems where dialogue between staff and users, users and database appears quite promising. An Expert System will help the librarian in realizing the need for an improvement in the productivity. A well programmed Expert System will also improve the quality.

4.1.1). Applications of Expert Systems in Reference Service:

Reference service is a prime activity of any library and the Expert System will work as a substitute for a reference librarian. Following are some of the examples of Expert Systems used for Reference Service.

(a) REFSEARCH: It is a system that supplies patrons, the recommended sources to lookup for certain question. The system can be used to teach students reference skills or as a computerized aid for practicing reference librarians and information specialists.

(b)POINTER: It was the early successful working application of computer system in the area of reference work. It directs the users to the reference sources; It is not a Knowledge Based System but a computer assisted reference program.

(c) Online Reference Assistance (ORA): This system intended to stimulate the services of an academic reference Librarian for questions of low and medium level, by using several technologies: a videotext like database, computer assisted instruction modules, and knowledge based system.ORA consists of Directional transactions like library locations, services and polices.

(d)AMSWERMAN: An Knowledge based system to help users for reference questions on agriculture topics. It uses series of menus to narrow down the subject of the questions and the type of tool needed. It can function as either a consultation system or as a front end to external databases and CD-ROM reference tools.

(e)PLEXUS: This is a referral tool used in Public Libraries. It includes knowledge about the reference process, information retrieval about certain subject areas, reference sources, and Library users. All the above systems are advisory systems for locating reference source books and factual data.

4.1.2). Application of Expert System in Cataloguing:

Cataloguing is one of the oldest library crafts. Recent attempts to automate cataloguing through Expert Systems have focused on descriptive cataloguing because it is considered rule-based(AACR2).There are two approaches for applying artificial intelligence techniques to cataloguing

a) A human-machine interface, where the intellect effort is divided between the intermediary and the support system; and

b) An Expert System with full cataloguing capability linked into electronic publishing system, so that as a text is generated on-line, it can be passed through knowledge based systems and cataloguing process is done without any intellectual input from an intermediary. There have been problem in every attempt to convert AACR2 into the highly structured rules necessary to run the Expert System.

4.1.3). Application of Expert System in Classification:

Classification is the fundamental activity in the organization of knowledge. For this reason it is prominent in all systems for organizing knowledge in libraries and information centers. Application of Expert System in the area of classifications in libraries includes the following:

(a).Coal SORT: It is a conceptual browser designed to serve either as a search or an indexing tool. Coal SORT consists primarily of a frame-based semantic network and the software needed to allow users to display portions of it and to move around in the conceptual structure. The expert knowledge in the system is embodied almost entirely in the semantic network. There is no procedural knowledge in the system.

(b) EP-X: The Environmental Pollution Expert(EP-X) has certain things in common with coal SORT in that both are concentrating on enhancing interface using a

Knowledge Based approach. The knowledge base of EP-X consists of hierarchical frame-based semantic network of concepts and a set of template that express the patterns called the pragmatic relationship among concepts. These patterns are referred to as conceptual information.

(c) BIOSIS: BIOSIS uses a knowledgebase, including a significant amount of procedural knowledge, to assign documents to categories automatically. It is designed as an indexer aid. BIOSIS uses the information in the titles of biological documents to assign as many categories as possible of those that would be assigned by human indexers. The indexing languages are tructured and practical representation of information that can be used to very good advantage of AI applications.

4.1.4). Application of Expert System in Indexing:

Indexing of periodicals is another area where expert systems are being developed. Indexing a periodical article involves identification of concepts, to translate these concepts into verbal descriptions, & selecting and assigning controlled vocabulary terms that are conceptually equivalent to verbal descriptions. The reason for automating the intellectual aspects of indexing is to improve the indexing consistency and quality. Based on the information provided by the information provided by the indexer, the systems can arrive at appropriate preferred terms automatically to assign relevant subdivisions. The system can make inferences & based on the inference, it can take appropriate action.' Med Index' is the best example of indexing system used in the library Indexing activity. Very few library users have interacted with knowledge based systems. In general, users have had very little contact with these systems due to the fact that most of them are not perfect enough to be used by the everyday library patron.

4.1.5). Application of Expert System in Acquisition:

The collection of documents is another integral part of the library. The librarian or the information officer is key person in this activity. The users of the library have a significant role to play in building electronic collections and that their help and advice should be solicited in the process. Several systems have been incorporated. Monograph Selection Advisor, a pioneering effort in applying this emerging technology in another area of Library Science i.e. building library collection. Specifically, the task modeled is the item-by-item decision that a subject bibliographer makes in selecting monographic. The knowledge base has to be broad enough and the interfacing aspect must be easy enough for the library to get the desired information from the machine.

V. APPLICATIONS OF NATURAL LANGUAGE PROCESSING IN LIBRARY ACTIVITIES:

When we think of the term NPL, the first thought one might have is of being able to speak or write in a complete sentence and have a machine process the request and speak. NPL can be applied to many disciplines. To apply this to the field of Library and Information science and more specifically to searching database such as online public access catalogue (OPAC)

Indexing is the basis for document retrieval."The aim of indexing is to increase precision, the portion of the retrieved documents that are relevant; and recall, the proportion of relevant documents that are retrieved". Key words, which have been weighted by the indexer as being basic to human thinking on a particular subject, will be fed into the electronic database in the way that will trigger the citing of an article or book on the computer screen, when these keywords are strung together in the proper sequence by the searcher. The main constraint is the variability in the ways a concept can be expressed. (aaai.org/AITOPICS,2014).This variability is partly a matter of semantics, i.e., using the word mobile home vs. trailers. The word trailer has been replaced by the word mobile home in most parts of the country.

Library patrons may not recognize the ambiguity of their search strategy. The use of natural language for Dialog database searches would allow the library patrons to search Dialog database directly, without the assistance of information professional. A patron using an electronic catalogue in a library may prefer to have the catalogue understand a complete sentence like "Find all your sources which contain an mention of natural language processing for the use of Library and information science." The human librarian has the advantage of being trained in search & query as well as natural language and can act as an intermediary between the machine and the library patron. Some URLs are also case sensitive. In the future, it may be possible to use natural language to access the website also. Library patrons must become computer literate to take the advantage of this new technology.

5.1 Application of Pattern Recognition in Library Activities:

In this era of the Internet and distributed, multimedia computing, new and emerging classes of information systems applications have swept into the lives of office workers and everyday people. New applications ranging from digital libraries, multimedia systems, geographic information systems, and collaborative computing to electronic commerce have created tremendous opportunities for information

researchers and practioners. As the application become more overwhelming, pressing and diverse, several well know information retrieval problems have become even more urgent in this network centric information age. The most fundamental techniques in IR involve identifying key features in objects. For example, automatic indexing & natural language processing are frequently used to automatically extract meaningful words. Texture, colour, or shape based indexing and segmentation techniques are often used to identify images. For audio and video applications, voice recognition, speech recognition, and scene segmentation techniques can be used to identify meaningful description in audio and video stream. Several classes of techniques have been used for semantic analysis of texts or multimedia objects. Symbolic machine learning, graph-based clustering and classification, stastistics-based multivariate analyses, artificial neural networks, and evolution-based programming are among the popular techniques. In this information age, we believe these techniques will serve as good alternatives for processing analyzing,& summarizing large amounts of diverse and rapidly changing multimedia information. The result from a semantic analysis process could be represented in the form of semantic networks, decisions, rules, or predicate logic. Spreading activation-based inference methods are often used to traverse various large-scale knowledge structures(aaai.org/AITOPICS,2014).

One of the major trends in almost all emerging information systems applications is the focus on the user-friendly, graphical, &seamless Human-Computer Interactions .The Web-based browsers for texts, images, and videos have raised user expectation on the rendering and manipulation of information. Recent advances in the development languages and platforms such as Java, OpenGL, and VRML and the availability of advanced graphical workstations at affordable prices have also made information visualization a promising area for research.

VI. ADVANTAGES OF ARTIFICIAL INTELLIGENCE

1. Can take on stressful and complex work that humans may struggle cannot do;
2. Can complete tasks faster than a human can most likely
3. To discover unexplored things e.g., outer space;
4. Function is infinite.

VII. DISADVANTAGES OF ARTIFICIAL INTELLIGENCE

1. Lack of human touch
2. Has the ability to replace human jobs.
3. Can malfunction and do the opposite of what they are programmed to do;
4. Can be misused leading to mass-scale destruction.
5. May corrupt the younger generation.

VIII. CONCLUSION

The numerous applications of Artificial Intelligence have been deployed, that demonstrated for the time saving, money to Business sectors, Industrial sectors, Military sectors, Scientific sectors, Academic and Research organizations. AI applications and their utilities will be increasing day by day in many IT oriented educational Institutions, which are contributing AI related recorded information on its AI technology and its utilities in various areas/subject fields. The success in Expert systems field, Natural Language Processing field, Pattern Recognition field, Robotics field has precipitated substantial commercial activity, including the formation of many ventures. The practicability of artificial intelligence in the areas such as cataloguing, classification, documentation, collection development etc appears to be improving year after year. It is sure that in the near future artificial intelligence will occupy in all the spheres with the introduction of competent models with AI techniques. Library and Information Science will be greatly benefited by the development of the efficient expert system for technical services as well as Information processing and management.

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