Expert Systems in Library and Information System

Poonam Gupta, Library Assistant, School Education Department, Union Territory of Jammu & Kashmir, India. E-mail address: guptapoonamudh@gmail.com

Abstract- Expert System has become a trending topic in the field of Library and Information System (LIS) likely as in the other fields such as in education, medicine, industries, health, agriculture etc. The meshing of Expert system with Library and Information System has improved the quality, accuracy and performance of the LIS field in providing various services to their clients and users. Expert System is basically knowledge based computer system and rule based system. It helps in various housekeeping operations and other important activities of Library and Information System like acquisition, classification, cataloguing, reference, information retrieval, indexing, Selective Dissemination Information (SDI), Current Awareness Service (CAS), online searching and archiving. In recent times, an application of an Expert System in Library and Information System has emerged as a great solution to solve various real time and complex problems that are difficult to solve by using the traditional methods. The knowledge of human expert like librarian or IT expert is used to create a knowledge based system that is called Expert System and runs by the intelligent agent that works as Artificial Intelligence (AI) or Expert System to support the operations and activities of Library and Information System (LIS). In this paper, firstly the concept of expert system and their components are discussed so that the students or the academic researchers properly understand what an Expert System is? This paper also emphasizes on the application of some Expert Systems in various sections and operations of the Library and Information System.

Keywords- Artificial Intelligence (AI), Expert System, Housekeeping operations, Human expert, Knowledge base, Library and Information System (LIS) etc.

I. INTRODUCTION

Today we see machines are doing the tasks which were earlier performed by the human. With a simple click or switch, we find our work without labor within a second or few minutes. Technology has surrounded every sphere of the world completely. The technology has replaced the human worker in performing various tasks. The machines perform tasks more efficiently than the human worker but only under human instructions. But it doesn't mean Technology made man. It's the only human who create technology and computer. Computer can never replace the Human brain. Computers are worthless without the human expert. It is the human mind who runs the computer. Artificial Intelligence, Expert System and Robotics have become the hottest topic in the recent times. These work as intelligent agents. These intelligent agents are used in various sectors. Expert System is a part of Artificial Intelligence (AI). Expert System is used in various domains such as designing domain, manufacturing domain, finance domain, diagnosis domain and Knowledge domain. In knowledge domain Expert System applied for publishing the appropriate knowledge for use. There are number of human experts with different skills and knowledge in different domains. These skills and knowledge are used by the technology. For getting relevant and efficient output, the knowledge gained by the human expert put into the expert system. The application of Expert System emerged as a solution to solve complex and real time problems that are difficult to solve by using the traditional system or methods in the field of Library and Information System. [1]

In Library and Information System, Expert System became its part since 1990. If we go back towards history of libraries and their system, that was totally traditional i.e. man oriented. Libraries were run by human and all its activities were performed by human that was more laborious and time wasting and consuming too. By the passage of time and with the introduction of computer and technology, libraries are shifting their paradigm of getting them automated. Like other areas, Library and Information System also started to utilize Expert System in various activities. The house keepings operations of Library and Information System are the pillars of this system that are very useful. Acquisition, Classification, Cataloguing, Circulation, Shelving, display and Serial Control are the house-keeping operations of this system [2]. Expert System is Knowledge based computer system and rule based system that helps in various housekeeping and other operations of LIS such as reference, retrieval instruction, indexing, Selective Dissemination of Information (SDI), Current

 DOI : 10.35291/2454-9150.2021.0087

Awareness Service (CAS), online searching and archiving [3]. Expert System acts like complementary system to the Library and Information System for making use of human expert's knowledge in decision making and problem solving. This system seems like competitor of human activities [4]. But these systems have great impact in Library and Information System. Expert System saves the time of library professionals in doing repetitious jobs and does the tasks with accuracy and efficiency than the man. There are number of projects based on Expert System to support the operational system in Library and Information System. National Agriculture Library (NAL) use an Expert System named REGIS as a reference aid to give response to patron's queries. CATTUTOR is an Expert System used by NAL to educate the cataloguer for creating bibliographic records for computer files. MedIndEx as an Expert System archetype is used by National Library of Medicine (NLM) for assigning thesaurus terms to medical literature [5]. Other few examples of Expert System are CUTT-X, N Cube, Shelf Pro *etc*. in Classification section of Library and Information System. CATALOG AID and MAPPER are used for cataloguing purpose in LIS. RAS, DISTREK, PLEXUS, TOMSEARCH *etc* are few examples of expert system used in reference section of LIS [6], [7].

Expert System also contributes towards education and academic research. It serves as a Research tool to solve a particular problem and helps the researcher to get the relevant knowledge in his respective field of interest. SNAP as an Expert System that contributes towards educational research. The production rule knowledge base is an important component of this system that is used for evaluating observational data [8], [9].

II. EXPERT SYSTEM

Expert System is one of the research fields in Artificial Intelligence. It is a part of Artificial Intelligence. Sometimes it may be regarded as Artificial Intelligence. It is based on knowledge and computer system. It performs various tasks which specially require human expertise. Expert System is used in solving specific domain problem by taking the help of human expertise. During early 1980's, Expert System came out from research laboratories and found in many fields such as engineering, medicine, diagnosis, chemistry, astronomy, industry etc.

The term "Expert System" stands for a system that stores and interprets the experience and knowledge of human expert by using computer technology. Edward Albert Feigenbaum has defined an expert system as "an intelligent computer programme that uses knowledge and inference procedure to solve problems that are difficult enough to require significant human expertise for their solutions". The first expert system was developed by Edward Feigenbaum and Joshua Lederberg in 1965. They designed DENDRAL to analyze chemical compounds. Now we see Expert systems have commercial applications [10]. Another example of early Expert System is MACSYMA that was developed by MIT for manipulation of algebraic expressions.

The functioning of an expert system is based on question and answer with reason. In user interface, asking question and answering with reason is seen. Expert system provides reasonable solution to a real time problem by acquiring the knowledge from human expert or knowledge engineer. An expert System always uses knowledge and inference for addressing and solving the problem that human expert would solve in particular expert's domain. In the kernel of an expert system, the knowledge contains facts and heuristics and rule of thumb to make decision and to solve problems and assists the human user within the domain in which the system operates.

Components of an Expert System:

The main components of an expert system are: a) Knowledge base b) Inference engine and c) User Interface. These are represented in figure 1.

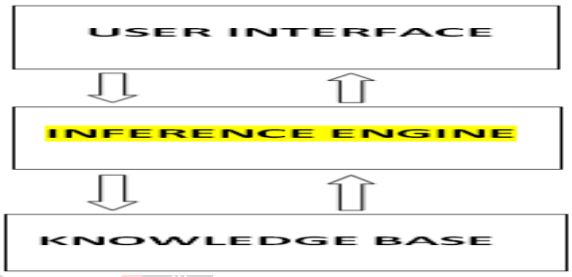

Figure 1. Components of an Expert System

a) **Knowledge base**: Knowledge base is the first main component of an expert system. It contains facts and knowledge about the domain of an expert. It is a store house of facts and heuristics. It can be represented in many ways, sometimes by simple facts or sometimes by complex frames. It employs rule based method, heuristic method and algorithmic method to generate reasonable, accurate and useful solution of the problem in a particular domain or area. These methods are used to represent the expert's knowledge and skills then the expert system uses the knowledge and gives the inference. For example IF-THEN-ELSE RULE is used to organize and formalize the knowledge. When the knowledge base is formed, the expert system starts o make inferences. The success of an expert system depends on the quality and accuracy of the information and knowledge stored in the knowledge base.

b) **Inference Engine**: Inference Engine acquires and manipulates the knowledge from the knowledge base to arrive at a particular solution. Number of rules and procedures are used by expert system to deduct a correct and reliable solution [11]. Inference Engine is

 DOI : 10.35291/2454-9150.2021.0087

the procedure of matching facts and union of facts to make a set of conclusion or decision. Then possible action is taken by the system. Inference Engine adds new knowledge into the knowledge base wherever required. Mostly two strategies are used by it for recommending the solution to problem and these are: Forward Chaining and Backward Chaining.

In Forward Chaining, an Expert System answers the question, "what will happen next?" and works on result or conclusion. So, the process of moving forward from known facts to conclusion or final decision is called Forward Chaining. It is aimed for any conclusion or final decision as shown in figure 2. The inference engine evaluates the known facts by matching with the available facts in the knowledge base, this process continues till the finding of final decision and the final goal or result is achieved. So, it is a data driven strategy.

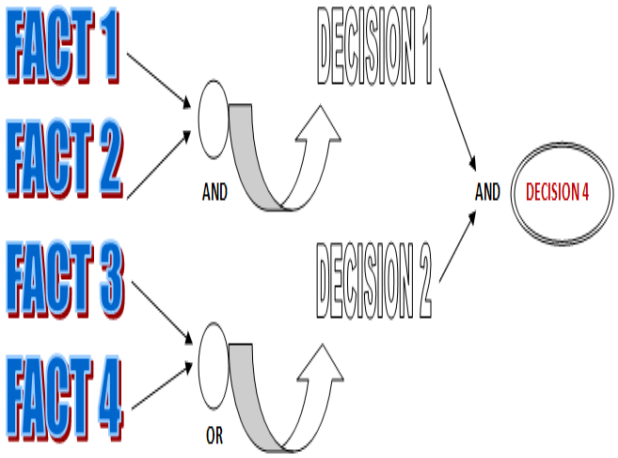

Figure 2. showing Strategy of Forward Chaining gives result or conclusion

In Backward Chaining, an Expert System answers the question, "why this happened?" and it works in finding out the cause and reason. So the process of moving backward from hypothesis or conclusion to known facts is called Backward Chaining. It starts from the final decision or goal for proving the facts as shown below in figure 3. So, it is a goal driven strategy.

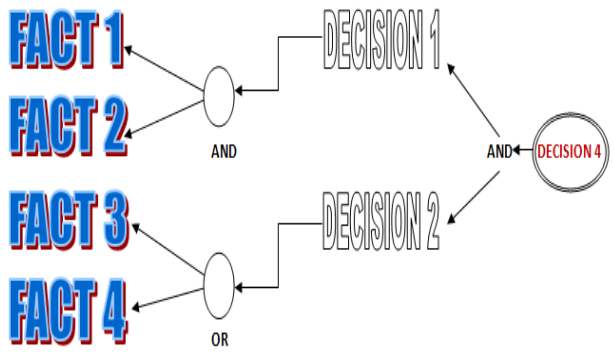

Figure 3. showing Strategy of Backward Chaining to find cause and reason

c) **User Interface**: User Interface allows the user to interact with the expert system. The user can ask the system to provide the answer with reasoning. It anticipates the needs of the user and then satisfies those needs. The user interface acts as software which allows interaction between the user and the system. The interface may contain pre-formulated questions and menus to facilitate the collection of data needed by the system in order to conduct the search of its knowledge base. The interface also provides the means of displaying the solution reached by the system.

III. APPLICATION OF EXPERT SYSTEMS IN LIBRARY AND INFORMATION SYSTEM

In Library and Information System, various operations are repetitive and tedious. Professionals get bored of doing such job. Expert System is the only way to get rid of such situation and it also helps in appointing some workers because machines do that job. Today we see libraries are combating with the invention of technology. Libraries are getting automated for their users and clients to satisfy them with the documents and information that they require. For effectiveness and increased efficiency, libraries are moving towards automation [12]. Expert System plays a great role in the field of Library and Information System. It is applicable in various sections of it such as administration, staff management, collection development, technical services, reference service and archiving [13].

There are various Expert System models used in the Library and Information System. Here, some expert systems are discussed below which are used in the activities of Library and Information System such as classification, cataloguing and reference service.

1. Classification:

For any type of library, Classification scheme acts as a backbone of library services. It helps in organizing information and knowledge and also in its timely retrieval [14]. It is the most difficult area for an Expert System. Research is progressing in the development of systems for assigning subject headings and class numbers (Iravis, 1990). If classification scheme is proper, all books will be used, every reader will get his book, every book finds its reader, it saves of the time of the reader and results in the growth of library for accessing all types of material to users and make them satisfy with the required information and document. It satisfies all the five laws of library Science which were given by Dr. S. R. Ranganathan who is the father of Library Science in India [15].

N-Cube: N-Cube expert system assist in classification of item by using the Universal Decimal Classification (UDC) standard. The n-Cube makes use of a tree classification

 DOI : 10.35291/2454-9150.2021.0087

structure with associated rules and default inheritance features. Any information known about a particular classification is a combination of the defaults known about that class, as well as the defaults associated with any of its parent classes. As a result, many of the problems associated with simple rule-based systems are overcome [16].

The N-Cube expert system reported by Cosgrove is an example of using expert system technology. This system combines shallow knowledge usually represented as production rules and deep knowledge usually represented in a frame structure (representing classification knowledge as an integration of object oriented structures with associated rules and hypotheses). The N-Cube architecture consists of a parent class, sub-classes, a ruleset, class inheritance and a set of hypotheses. This is represented as a tree structure which is searched based upon information in the bibliographic elements of a title to be classified. When a rule (one or more facts) matches a node in the tree, it is verified via a user or a knowledge base of facts and its classification number is extracted. The node's sub-tree can then be searched to determine more specific extensions to the base number as desired [17].

CUTT-X: It is a system of assigning automatic cutter number. It was developed by making use of Microsoft Access Relational Database. This Expert System assimilates with classification system. A form is used for monograph entry and its processing. This entry form takes information like author and main title. This monograph entry form also offers Book Label printing function. The DDC classification number is combined with cutter number. A very special type of printer prints the book spine label. The CUTT-X expert system has same structure like a classical Expert system such as: user interface; inference engine and knowledge base. It starts with information input, goes through input identification, normalization, demarcation, matching process, assigns the cutter number and the initial letter, and at the final stage displays the result-the complete cutter number [18].

Shelf Pro: Shelf listing is a highly dexterous task. Near about ninety percent staff is required for doing this task. The Shelf listing is an essential process. To complete the process of classification or assigning call number to a document, a relatively simple table is used to translate the designated cataloging data item into an alphanumeric "cutter number". So, Shelf listing is concerned with assigning a book number to an item as opposed to the class mark position of the call number. ShelfPro was developed by Drabenstott [19].

2. Cataloguing:

A Cataloging in Publication record is a bibliographic record prepared by the Library of Congress for a book that has not yet been published. When the book is published, the publisher includes the CIP data on the copyright page thereby facilitating book processing for libraries and book dealers [20]. The presence of AACR2, the MARC format, Library of Congress Rule Interpretations, OCLC manuals, and a number of other interpretive guides for cataloging form precisely the kind of knowledge which is transferable to the knowledge base of an ES. Additionally, the local practices of cataloging lend https://www.loc.gov/publish/cip/ themselves to formalization in rules that can then be input into an ES to enhance local utility. Cataloging is also a small domain, and ES must focus on a limited domain in order to be effective [21], [22]. Clarke and Cronin predict two paths of development for cataloging ES. The first path views ES as an intermediary and an assistant with much of the intellectual work still left to the human. The second path views ES as completely automating the cataloging process, from publication to shelf preparation, with no human intervention. It should come as no surprise that these prototypes succeeded exclusively in terms of the first path [23]. Expert systems have been developed to create MARC record and to apply some of the rules in AACR-2 for cataloguing. Roy Chang developed a cataloguing expert system based on the rules in AACR-2. He determined that its usefulness was limited because the system had no means of interpreting the rules. In this opinion 'cataloguing problems today are too widespread for employing an expert system (Chang, 1990).

CATALOG AID: Roy Chang constructed a system from a computer language called Prolog to complete his degree in Computer Science. Prolog is a symbolic computer language, where statements are represented in terms of their actions and the agents. The statement “Smith catalogs books,” for example, is expressed in Prolog as catalogs (smith, books). The author presents a thorough analysis of Prolog that is outside the scope of this paper. It is relevant, however, that his system was more laborious to construct, since he not only transferred part of AACR2 to the knowledge base, but also wrote the inference engine with Prolog. As with the other three systems, users are cued to enter information, this time in yes/no format, rather than from a menu, to which the ES replies with the correct AACR2 rule to apply. Again, this is an assistive expert system in Clarke and Cronin's context, and very much like Expert Trees in terms of the user interface [24]. Also, as with the other three expert systems, this one was never used in practice, and at one point Chang himself appears to condemn it as useless unless it were set up to handle the exceptions to what catalogers do, rather than the regular daily work. Chang concludes by noting the processor-intensive nature of Expert System, which echoes concerns from the other three projects. Although Chang has constructed a prototype system, his work is rarely ever cited again.

 DOI : 10.35291/2454-9150.2021.0087

MAPPER: Ercegovac and Borko describe a prototype expert system for map cataloging according to AACR rules. Cataloging map is a very narrow domain and suits the limitations of expert system well. MAPPER is another example of Clarke and Cronin's first type of Expert System, in that it is menu-driven and assists the user in choosing the main entry, title statement, statement of responsibility, publisher, place and year of publication for a map [25]. These researchers made strides in designing and testing ES for cataloging, in that they included knowledge from map catalogers as well as AACR2 in the knowledge base, and they formally tested the system for ease of use and accuracy. Determining usability was done by having many students test MAPPER and evaluate it on a standard scale, and accuracy was checked by comparing MAPPER-produced answers to the decisions of the Library of Congress made when cataloging identical maps. The tests for accuracy and usability were not performed on any of the four systems previously described, and represent an improvement in the construction of Expert System for cataloging [26]. Ercegovac earned a Ph. D. for her role in the MAPPER project, but MAPPER is seldom mentioned again in literature in cataloging and technical services. These five prototypes represent a decade of enthusiasm about the use of ES in cataloging. However, Meador and Wittig's prediction that "a workable expert system will probably become ready sometime during the 1990s" simply did not happen. There are many reasons for this failure, some a product of the research, others observations by this author.

ESSCAPE: Hjerppe, Oskins and Marklund (1985, 1989) conducted the well known ESSCAPE project in Sweden. They build a prototype rule-based expert system at OCLC known as OCLC Automated Title Page Cataloguing Project to automate descriptive Cataloguing from title pages. Following on the heels of the Davies and James experiments, Hjerppe and Olander reported on the creation of two Expert Systems for cataloging [27]. Their project, titled ESSCAPE (Expert Systems for Simple Choice of Access Points for Entries), produced two ES that were viable in the laboratory at Linköping University. Both were built with Expert System's shells commercially available at the time, EMYCIN and Expert Trees. Both shells resulted in different products, however. ESSCAPE/EMYCIN was developed with the intent of producing a complete cataloging record, while ESSCAPE/Expert Trees simply resulted in advice on which AACR2 rule should be used. EMYCIN is a shell with a backward chaining inference engine, the top goal of which is a complete bibliographic record. The prototypes did not use ISBD punctuation, but the authors noted it would be simple to program the ES to do so. Users are cued for certain information about the item in hand and ESSCAPE/EMYCIN produced a record based on the input. The authors noted several limitations, however. This Expert System could not properly handle works of mixed responsibility always treated collections as if they had a collective title, always treated the first author as the principal author, and did not consider the forms of the headings in the record (performed no authority work). However, since this ES was intended to produce a complete cataloging record, it is closer to Clarke and Cronin's second path for Expert System development than the other prototypes.

3. Reference Service:

One of the basic objectives of every library and information centre is to save the time of the user as well as to provide specific information as quickly as possible. The method used for the same involve personal efforts to bring together user. Hence this method of providing personal attention to readers in terms of meeting their specific needs is given the name 'Reference Service' [28]. According to Dr. S. R. Ranganathan, in the present electronic and communication environment reference service is not only confined to the library service but also to remote users. Sometimes it is termed as e reference service, Digital reference service, Virtual reference service, its main objective is to provide pin-pointed, exhaustive, expeditious service to its information seekers whenever they have a query.

RAS (Reference Advisory Systems): It is an expert system developed at San Diego State University to assist in providing reference services. The RAS system provides a natural language interface to reference service in the areas of materials science, public health nursing and computer science. A reference advisory system (RAS) is a public access expert system that provides reference suggestions based on user information needs. It is designed to run without the presence of the "expert." The assay mark of the RAS is ease of construction and update [29].

DISTREK: It is an expert system to link with a unit catalogue or CD-ROM in new southwest Mc Donald and Weckert (1990). In Johnson Library of Government Documents of stand for University developed the Government Document Reference Aid (GDRA).

PLEXUS: PLEXUS expert system is used in order to provide online assistance during online database search. PLEXUS has demonstrated the usefulness of Artificial Intelligence techniques in formulating and revising search strategies. It also served as a prototype for the development of a commercial product, Tome Searcher, which is an intelligent interface for online searching of database on remote hosts, the initial version covering the domains of electrical/electronic engineering, computer science and information technology (Vickery, 1988). No prior referral system employed such a range of knowledge, representation techniques-semantic nets, frames and rules and PLEXUS was also distinctive in its use of a user model to control the

 DOI : 10.35291/2454-9150.2021.0087

explanations given by the system and to order the output of references so that those in the most accessible libraries or other centres were given first.

Ready Reference Advisor (RRA): It assists users in finding answers to common library reference questions. The system was developed for the National Agriculture Library (NAL). The system was written using an expert system development tool called 1st class (Forrester & Garner, 1991) [30]. A second system implemented with 1st class is the Finders system. Finder was developed for the Economic Research Service of the Department of Agriculture. Finder guides users to the information they are seeking by using menu based system.

IV. SUGGESTION

In my published book chapters, various preventive measures and strategies have been given for the opening and running of the libraries during and after lockdown [31], [32]. But, through this paper, the most innovative expert system like Librarian Robot can act as a suggestive tool during Covid-19 pandemic that can actively run the library and information system without getting affected in any way.

V. ACKNOWLEDGMENTS

Firstly, I thank to the Almighty God for His blessings. Secondly, I would like to express my special thanks and gratitude to my husband (Dr. Nasseb Singh) for his guidance and support from time to time despite of his busy schedule.

VI. CONCLUSION

If there is question arise about the occurrence of Expert System in Library and Information System then the response is always in positive. Library and Information System are looking forward towards the automation and modernization. Various Expert System projects have installed and used by many big libraries but these are very costly and due to budget constraints every library cannot go through it. Online vendors provide open architecture and models of these systems that make possible for the libraries to modify them and their library system and services and develop their own knowledge based architecture. Very few library and Information System appeared in the public domain with little commercial success. The counting of impressive and compatible Expert System is limited. Librarian Robot is an innovative type of expert system that is more helpful in doing the usual and repetitive tasks like as the real human does. It performs the tasks at the same level of energy and expertise and available instantly. It stays always from the influence of human as it is a machine. Knowledge engineers and researchers are engaged in experiments and to equip commercial expert systems in library and information domain in many countries. It is concluded that expert systems through their applications in various sections of Library and Information System have given a new direction to remain active in emerging new digital world.

REFERENCES

[1] Gupta, I. & Nagpal, G. *Artificial Intelligence and Expert Systems.* Dulles, VA: Mercury Learning and Information.

[2] Kumar, K. (1987). *Library Administration and Management*, Delhi: Vikas Publishing.

[3] Cavanagh, Joseph M. A. (1989*). Library Applications of Knowledge Based Systems. Expert Systems in Reference Services.* Newyork, London: The Haworth Press. ISBN- 0-86656-839-5

[4] Asemi,A. Ko, A. & Nowkarizi, M. (2020). *Intelligent libraries: a review on expert systems, artificial intelligence, and robot.* Retrieved from: https://www.emerald.com/insight/content/doi/10.1108/LHT-02-2020-0038/full/html

[5] Avra, M. (March, 1991*). Expert Systems Technology and its implication for archives; National Archives Technical Information Paper no. 9*. Washington, DC: National Archives and Records Administration. Retrieved from: https://files.eric.ed.gov/fulltext/ED344605.pdf

[6] Drabenstott, K. M., Reister, L., & Bonnie, D. A. (1992). *Shelflisting using Expert system in Classification Research for Knowledge Representation and Organization.* Amsterdam: Elsevier.

[7] Ercegovac, Z., & Borko, H. (1992).Design and implementation of an experimental cataloging advisor-Mapper. *Information Processing andManagement*. Pages 241-257 Retrieved From:https://www.sciencedirect.com/science/article/abs/pii/0306457392900485

[8] Davis, R., Buchanan, B & Shortliffe, E. (1975). *Production Rules as a Representation for an Knowlwdge- Base Con sultant Program.* Report STAN-CS-75-519 MEMO AIM-226. Palo Alto, CA: Standford University

[9] Jacqueline A., Haynes, Virginia M. Pilato & David B. Malouf. (1990). *Expert Systems and Intelligent Computer- Aided Instruction; (*The Educational Technology Anthology Series; Vol.2); *Expert Systems for Educational Decision Making*. New Jersey: Educational Technology Publications.

[10] Zwass, V. *Expert System.* Retrieved From: https://www.britannica.com/technology/expert-system#ref710099

[11] Schnupp, P., Nguyen Huu, C. T. & Bernhard, L. W. (1989). *Expert Systems Lab Course.* London: Springer-Verlag Berlin Heidelberg.

 DOI : 10.35291/2454-9150.2021.0087

[12] Dwivedi, Y. K., Kapoor, K. K., Williams, M. D. & others. (2013). *RFID systems in libraries: an empirical examination of factors affecting system use and user satisfaction*. International Journal of Information Management, Vol. 33 No. 2, pp. 367-377, doi:10.1016/j.ijinfomgt.2012.10.008

[13] Rahi, Falah H. (April, 2019). *Expert Systems in Libraries information and library science.* DOI: 10.13140/RG.2.2.27563.08483 Retrieved From: https://www.researchgate.net/publication/332472545_Expert_Systems_in_Libraries_information_and_library_science_Prepared_by_Falah_H_Rahi

[14] Pandita, R. & Singh, S. (2012). *NEED AND IMPORTANCE OF LIBRARY CLASSIFICATION IN ICT ERA.* Retrieved From: https://www.researchgate.net/publication/260433354_NEED_AND_IMPORTANCE_OF_LIBRARY_CLASSIFICATION_IN_ICT_ERA

[15] Sharma, C. K. & Sharma, Amit K. (2007). *Library Classification*. New Delhi: Atlantic Publisher.

[16] Cosgrove, S. J. & Weimann, J. M. (January, 1992). *Expert system technology applied to item classification*; *Library Hi Tech*, Volume 10 Number 1/2, pp. 33-40. Website: https://doi.org/10.1108/eb047841 ISSN: 0737-8831

[17] Savic, D. (1994). *Designing an expert system for Classification of office documents. CLOD ARMA. Quaterly, 28*(3).

[18] Savic, D. (1996). *CUTT-x: An Expert System for Automatic Assignment of Cutter Numbers*. Retrieved from: https://www.researchgate.net/publication/265269121_CUTT-x_An_Expert_System_for_Automatic_Assignment_of_Cutter_Numbers [accessed Dec 09 2020]. Cataloging & Classification Quarterly 22, July 1996 *(2)* : 71 - 87

[19] Drabenstott, K. M., Reister, L., & Bonnie, D. A. (1992). *Shelflisting using Expert system in Classification Research for Knowledge Representation and Organization.* Amsterdam: Elsevier.

[20] *Cataloging in Publication Program*. Available at: https://www.loc.gov/publish/cip/

[21] Carrington, B. M. (1990). *Expert systems: power to the experts*. Database 13: 47-50.

[22] Chang, R. (1990).*Developing a cataloging expert system. Illinois Libraries* 72: 592-596.

[23] Clarke, A. & Cronin, B. (1983). *Expert systems and library/information work.* Journal of Librarianship 15: 277-292. https://doi.org/10.1177/096100068301500404

[24] Hjerppe, R. & Olander, B. (1989). "Cataloging and expert systems: AACR2 as a knowledge base," *Journal of the American Society for Information Science* 40, no. 1 (1989): 27-44.

[25] Ercegovac, Z. & Borko, H. (1992).Design and implementation of an experimental cataloging advisor-Mapper, *Information Processing and Management* 28; 241-57.

[26] Sauperl, A. & Saye, J. (1999). "Pebbles in the mosaic of cataloging expertise: what do problems in expert systems for cataloging reveal about cataloging expertise?," *Library Resources and Technical Services* 43, no. 2; 78-94.

[27] Hjerppe, R. & Olander, B. (1989). Cataloging and expert systems: ACCR2 as knowledge base.*Journal of the American society for Information Science, 40*(1). Retrieved From: https://econpapers.repec.org/article/blajamest/v_3a40_3ay_3a1989_3ai_3a1_3ap_3a27-44.htm

[28] Chandwani, A. *An overview of Digital Reference Services.* Available at: http://eprints.rclis.org/14295/1/DIGITAL_REFERENCE_SERVICES.pdf

[29] Carande, R. (1989), "Reference Advisory Systems (RAS): Some Practical Issues", *Reference Services Review*, Vol. 17 No. 3, pp. 87-90. Retrieved From: https://doi.org/10.1108/eb049069

[30] Forrester, C. L., & Garner, B. J. (1991). *Knowledge-based support for library users: Libraries and Expert Systems.* London: Taylor Graham.

[31] Gupta, P. (2021). *Academic Libraries in India Amidst Covid-19 Pandemic: Influences and Strategies for Reopening*. Book- Impact of Covid-19 on Economy, Business, Education and Social Life. Maharashtra: KD Publications. pp 102-109. ISBN- 978-81-948755-9-8 URL Link: https://books.kdpublications.in/index.php/kdp/catalog/book/34

[32] Gupta, P. (2020). *Impact of Covid-19 on Academic Libraries in India.*Book- Panorama on Commerce and Management. New Delhi: National Press Associates. pp 12-19. ISBN- 978-81-948872-8-7

 DOI : 10.35291/2454-9150.2021.0087