CHAPTER 2

REVIEW OF LITERATURE

2.1 INTRODUCTION

There is a widespread interest and consequently a number of research and development activities are being carried out in the area of digital library. A number of institutions are also in the process of setting up digital libraries and many scholars and practitioners are conducting research on digital libraries.

The literature review was limited to published articles covered LISA (Library and Information Science Abstract) to gain insight, assess and understand the digital library, digital materials, online resources, digital library hardware and software, digital library access / architecture, digitisation materials, method, resources, reasons, challenges in the university libraries of Tamil Nadu as reflected through scholarly journals, conference papers on digital libraries have been reviewed under abstracting databases available in Internet and few primary journals.

Based on this review, following categories have been made on the basis of subject coverage to present the related articles very systematically.

i. Digital Library
ii. Digital materials
iii. Online resources
iv. Digital library hardware and software
v. Digital library access / Architecture
vi. Digitisation
2.2 DIGITAL LIBRARY

A digital library is a highly organised collection of electronic resources. Digital libraries share an important characteristic with search engines they can both be accessed online. However, while search engines cover a wide range of subject areas, digital libraries are more narrowly focused around one or a specific group of disciplines. Unlike search engines, digital libraries attach content specific and highly descriptive metadata to describe each item in the collection. When a user conducts a search in the digital library it is this metadata that is searched. Search engines, on the other hand, search "blindly" on an item's content and the results obtained may only indicate that a particular search terms appears somewhere in the item and not whether the overall content of the item is relevant to the search. Therefore, searches in a digital library produce more useful results, save users time and effort in searching and users can access the information found instantly. Digital library is a very complex and dynamic entity. It has brought phenomenal change in the information collection, preservation and dissemination scene of the world.

The digital library access and accessing knowledge of digital library in university libraries were discussed by Angel Garcia et al (2011)\(^1\) digital library constitutes a fundamental subject of research. Among the challenges of classifying, locating and accessing knowledge in digital libraries tackling with the huge amount of resources the web provides, improving digital libraries by means of different strategies, particularly using semantics remains a promising and interesting approach. A semantic based digital library which provides faceted search, enhanced access possibilities and a proof-of-concept implementation.

Jesus Serrano et al. (2011)\(^2\) says that digital libraries are mainly based on the interaction between users through collaborative applications such as wikis, blogs, etc or new possible paradigms like the waves proposed by google. This new concept, the wave represents a common space where resources and users can work together. The problem arises when the number of resources and users is high, then tools for assisting the users in their information needs are necessary.
Discussing about the impact of a digital library by Malizia et al. (2010)\(^3\) the design and development of a digital library involves different stakeholders such as: information architects, librarians and domain experts, who need to agree on a common language to describe, discuss and negotiate the services the library has to offer. To this end, high level language, neutral models have to be devised. Meta modeling techniques favor the definition of domain specific visual languages through which stakeholders can share their views and directly manipulate representations of the domain entities.

Luong et al. (2010)\(^4\) analysed that scholarly digital libraries increasingly provide analytics to information within documents themselves. This includes information about the logical document structure of use to downstream components, such as search, navigation and summarisation.

Xiao (2010)\(^5\) explained the respective functions of organisations and libraries, information resources, services, methods and the interactions between them. Originality value innovatively, the theory of three dimensional structures is applied to the discussion of the development of the digital library service system. It is significant for the integrality of a digital library theoretical system, as well as for the practical developments, innovations and sustainability of the digital library.

Digital library has brought a tremendous change in the field of libraries. Vijayakumar and Gopalakrishnan (2010)\(^6\) discusses his paper, paperless society is becoming a reality to some extent in all the libraries including academic libraries, e-resources which are important resources in a digital library are being widely used by the user. Earlier only a few academic libraries including the special libraries has access to digital libraries. This library is nothing but a library where the collections are available in the digital format.

Trivedi (2010)\(^7\) observed that emerging technology for digital libraries can drastically improve the management of resources of libraries. The advantages of having digital libraries are now well understood by librarians, technologists and
others. Several factors play a major role in digitisation of materials for the transformation of a library from traditional to digital.

Byamugisha (2010)⁸ paper discussed that people have become increasingly dependent on digital information and the internet as a medium for gaining and exchanging information. However, despite promising developments, numerous challenges that are related to digital content and collection, interoperability, standards, knowledge organisation systems, users and usability, legal, organisational and social issues, staff education, infrastructure, language barrier and technology remain. Digital libraries can assist human development by providing a non commercial mechanism for distributing humanitarian information on topics such as health, agriculture, nutrition, hygiene, sanitation, water supply and many other areas ranging from disaster relief to medical education.

Ramakrishna (2009)⁹ says that digital library provides users a single window access to structured information from their desktop. A physical digital library has been created to enable access to different categories of documents such as journal articles, conference proceedings, standards, e-books etc., downloaded or purchased, access is free round the clock to in-house users.

Khoo (2009)¹⁰ discussed that digital library systems require evaluation for many reasons, such as supporting funding and sustainability and to give feedback to digital librarians and digital library management on ongoing library operations. Available academic evaluation techniques may be high effort and seek higher levels of confidence and deeper claims than are needed or appropriate. Lightweight evaluation methods can therefore play an important role in digital library research.

Blasi (2009)¹¹ analysed that the digital libraries along two exclusive directions a) digitisation and preservation of historical materials and b) creation of digital repositories and other digital services in universities. All theoretical and institutional efforts are oriented towards these two areas of interest. Libraries instead whose users are less interested in scientific articles and ancient manuscript or book.
Hakala (2009)\textsuperscript{12} focused on the digital library as a place that enhances informational and cultural heritage, where collections are digitally managed, preserved and are accessible by computers. The traditional metadata system that has served these functions well so far is about to become antiquated, since it lacks the ability to store certain important electronic data.

Tjondronegoro and Spink (2008)\textsuperscript{13} described the rapid advances of information technologies have allowed for the inclusion of vast amounts of electronic information in digital libraries. This electronic information initially was primarily text based, but it has expanded to include graphics, animation, audio, video and interactive media. Thus, the ability to help users easily, efficiently and conveniently retrieve multimedia information from the vast array available presents both an opportunity and a challenge for modern digital libraries.

The digital library functions within the cycle of the creation, dissemination, disposal and use of born digital and digitised content. Lor (2008)\textsuperscript{14} discuss the different types of digital libraries are identified and challenges in selection, acquisition, organisation, preservation, resource discovery and access. Technological factors are not the main issue to be addressed. Rather, it is emphasised that political and economic challenges require attention. A rational and holistic discipline of digital resources management is needed to ensure that digital content can be handed down to posterity.

Bearman (2007)\textsuperscript{15} explained the digital library developments in India began rather slowly in mid, 1990s and have gathered momentum at the turn of the century. Libraries of S & T organisations have developed a number of digital library initiatives. This may have to do with the fact that S & T libraries have greater economic and human resources by far to undertake digitisation programmes. Even in the library automation era, it was the S & T libraries that took the lead in computerisation activities.

According to Pomerantz and Marchionini (2007)\textsuperscript{16} digital libraries are built and as more physical libraries offer electronic access to parts of their collection, two
trends are likely to result: the role of the library as a storage space for materials will become decreasingly important; and the role of the library as a space for users, for individual and collaborative work and as a space for social activity, will become increasingly important. Digital libraries are unable to fulfill some of the functions of the physical library as physical spaces, but are able to offer functions beyond what the physical library can offer as cognitive spaces.

Further Buehler and Traurnicht (2007)\textsuperscript{17} the development of a digital library, created and maintained by an academic library, and its gradual change into the institutional repository. Other libraries in the planning stages or initial steps of creating a campus wide digital library or an institutional repository can benefit from the description of possible successes and problems that they could encounter during implementation.

Abdullah and Zainab (2007)\textsuperscript{18} analysis the digital library of historical resources, a research project which involves building a testbed for the purpose of developing and testing new collaborative digital library functionality and presents an initial analysis of the digital library's public use on the web. The digital library is modeled to focus on serving secondary students information needs in conducting history projects. As such, in the implementation of the digital library, the use of online resources would be an integral part of history project based learning activities.

Seadle and Greifeneder (2007)\textsuperscript{19} discuss that digital library to see whether one can be constructed that usefully distinguishes a digital library from other types of electronic resources. At this point, digital libraries are evolving too fast for any lasting definition. Users readily understand are too broad and imprecise. A functional definition of a digital library would add clarity to a burgeoning field, especially when trying to evaluate a resource. The student perspective provides a fresh look at the problem.

Goncalves et.al (2007)\textsuperscript{20} opined that a model that is deeply grounded in a formal framework for digital libraries: 5S (Streams, Structures, Spaces, Scenarios,
and Societies). For each major DL concept in the framework we formally define a number of dimensions of quality and propose a set of numerical indicators for those quality dimensions. In particular, we consider key concepts of a minimal DL: catalog, collection, digital object, metadata specification, repository and services.

Digital libraries are increasingly serving a worldwide audience. Smith (2006)\textsuperscript{21} proposes that Persons of different cultural backgrounds can hold diverse perceptions of what constitutes an effective, efficient and satisfying information seeking experience and digital library design therefore grows more complex when its user population traverses cultural boundaries.

Cabral Vargas (2006)\textsuperscript{22} explored that the digital library and proposes some guidelines as a starting point toward user satisfaction in digital information services. Digital libraries belong in the learning environment, with emphasis on learning and content, so that users learn something new. No pretence is made to deal with this issue in an exhaustive manner or to define concepts, but to establish a relationship between the two.

Pour (2006)\textsuperscript{23} analysis that the digital library development of different information formats, possibility of quick transmission of the produced information through networks, advancement of computer software and hardware, development of Internet and Intranet communication networks in the countries and multimedia great abilities for simultaneous transmission of text, sound, image and movie have caused a great revolution at information area. A new technology to store, retrieve and use of such a great and various amounts of informative texts, audio visual resources, images and so on that called digital library.

According to Gupta and Singh (2006)\textsuperscript{24} the digital library is conceptualised as local view that would have the same design as the web page of the library and offers a localised view of the digital library not extending the access to databases for which a specific library may not subscribe to. Such a library is not restricted to linear, print like documents and hence, may also be able to be accessed for different electronic media on different servers from one single entry point. The access to
digital Library should be platform independent which could be accessed from any part of the world.

Patra (2006)\textsuperscript{25} state that digital library on ceramics is needed to provide students, scientists, artist and industrial community with an open and interoperable platform to help facilitate research and education, to promote ceramic art, to promote global cooperation, to foster economic development - including rural development and to help facilitate archaeological research. It is a paradox that, under circumstances where economic activity takes place at an increasingly global level, individual countries must give increased attention to their performance at the national level so that they can find a favored position within the world community.

According to Kani-Zabihi (2006)\textsuperscript{26} explained the digital libraries, their requirements with respect to specific features may change. Involving users in digital library design should be an integral step in the process of building a digital library, in addition to the classic roles of evaluation and testing experts. Digital library design from a new perspective, giving users an opportunity to express their suggestions on future functionality and features of digital libraries.

According to Castelli (2006)\textsuperscript{27} the digital library will provide a seamless environment where the cooperative access, filtering, manipulation, generation and preservation of these documents will be supported as a continuous cycle. Policy ensuring mechanisms will guarantee that the information produced is visible only to those who have the appropriate rights to access it. The realisation of these new digital libraries requires both the provision of a new technology and a change in the role played by the libraries in the information access production cycle. Digital libraries of the future will be core instruments for serving a large class of applications, especially in the research field.

Chowdhury (2006)\textsuperscript{28} point out the various technical aspects of digital library design (e.g. architecture, interfaces and search tools), there are a number of usability issues such as globalisation, localisation, language, culture issues, content and human information behavior. Digital libraries are evaluated primarily with respect to
their target users, applications and contexts. Although a digital library evaluation study may have several objectives, ranging from the evaluation of its design and architecture to the evaluation of its usability and its impact on the target users.

Sharma and Arora (2005)\textsuperscript{29} highlighted the need for digital libraries along with the requirements, digitisation process and future of digital libraries.

Sreekumar and Sunitha (2005)\textsuperscript{30} who share the experience of creating a State-of-the-art digital library information system by seamlessly integrating and aggregating print as well as the diverse distributed digital content of the Indian Institute of Management, Kozhikode knowledge domain.

Shukla (2005)\textsuperscript{31} further discusses content creation as a new trend in IT and stresses the need to develop digital libraries and not digital collections. The author emphasises that care should be taken to surround collections with appropriate metadata supplying context and interpretation to develop synergy.

Fast and Sedig (2005)\textsuperscript{32} emphasise that the reconceptualisation of digital libraries as interactive knowledge environments calls for applying information visualisation techniques to bring about the transformative changes.

Sonkar et al (2005)\textsuperscript{33} studies that digital library emerging as a trend in the present era, the information society of today suffers not from the lack but from a surplus of information. Distinguishing relevant from non relevant information is therefore, one of the main tasks of librarians. The development of information technology in the field of digital libraries has attracted many research efforts during the last years. Many interesting projects have been started, dealing with the various open issues arising in this field addressing the challenges such as metadata selection, preservation, technology obsolescence and copyright issues, etc.

Bhattacharya (2004)\textsuperscript{34} discussed the development of digital libraries with respect to India and concluded that India’s attempt towards digital library development has been sporadic and partial.
Krishnamurthy (2004) focuses on the overview of digital libraries, describing the Digital Library Initiative – Phase I and Digital Library Initiative – Phase II projects. He also touches upon research issues involved in digital libraries such as interoperability, collection development and management, preservation, cataloguing and indexing and reference services.

Arora (2004) as information sources are increasingly available in digital form, it is natural that any digital library would have different kinds of digital formats and sources, a variety of digital collections. These include e-journals, in-house born digital collections such as theses, scanned books, CD ROM databases, the library OPAC and courseware.

Das and Dutta (2004) discuss the need for audit and control of digital library systems. The authors identify the elements of audit and control that enhancing the capabilities and effectiveness of digital libraries.

Many institutions and universities in developing countries experience great difficulties in accessing bibliographic resources. Witten (2004) discus that digital libraries show up as an opportunity to resolve such problems, providing access to the most recent publications in a quick and reliable manner.

Hartson et al. (2004) examined the analysis of the evaluation raised numerous problems found in evaluating digital libraries. A lack of research was highlighted in techniques to effectively evaluate digital libraries along with the issue that they as usability specialists do not have extensive knowledge and experience with digital libraries and can only evaluate using general guidelines established for systems, highlighting the research requirement for a usability evaluation technique specific to digital library evaluation.

Giersch et al., (2004) outlined the several models for building and maintaining digital libraries, a model that involves participants who have varying strengths, needs, experiences and interests should make a significant difference in the design, development and utility of digital libraries for education.
Development of a model or models that describe participant involvement should enhance the likelihood that multiple users can be effectively involved in all facets of the digital libraries. Thong (2004)\textsuperscript{41} investigated to make effective users adaptations, research must involve finding out what the potential users already know, what their misconception and problems might be and what they would be interested to do and learn in a digital library environment. In order to increase the acceptance and relevance of a digital library contents to user’s needs, researchers should concentrate on user requirement analysis to discover expectations and content demands to incorporate into a digital library.

Jeevan (2004)\textsuperscript{42} attempted to find out the digital library development should be taken up as an additional task to populate the web sites with valuable in-house content like the research reports, publications of in-house researchers and so on. Digital library projects and developments in the country are so many, though a large number of them are only at an aggressively enthusiastic preliminary stage. Especially in developing countries, is a coordinated collaborative approach to bring in institutions and identifying content valuable for digitisation with sufficient monetary and infrastructure support.

Zaphiris et al. (2004)\textsuperscript{43} explore the application of information visualisation in digital libraries and identify three key tasks in digital libraries, namely searching, browsing and navigation to which information visualisation can make a contribution.

Fox and Urs (2002)\textsuperscript{44} says that the digital libraries are becoming the main repository library and information centers and as a result the design of user friendly interfaces to access, understand and manager digital library content has become an active and challenging field of study.

In an elaborate study Witten et all (2001)\textsuperscript{45} digital libraries give the ICT professionals a great opportunity in reversing the gap created by the ICT in these countries on the other hand, digital libraries have particular relevance in developing countries, since the traditional publishing and distribution mechanisms have failed tragically.
McCray and Gallagher (2001)\textsuperscript{46} give an overview of issues concerning HCI, Usability and Accessibility of digital libraries. The system must be accessible to the vast majority of users regardless of disability, language or cultural differences. The information should be easy to find using keyword searching. The interface should be intuitive with the keyword search easy to find as well as the ability to browse topics. Information should be optimised so that the retrieval of information is quick. Good indexing is vital so that the search terms can be well matched in results and results found quickly.

Blandford et al. (2001)\textsuperscript{47} noticed that the differences between users interactions with the digital library when browsing and searching. A user’s priority regardless of discipline is how easily they can interact with a system, how quickly they can receive results to their query and how relevant the results are to their query. This is the same for any information retrieval task. They also identify a problem when assessing the usability of multiple digital libraries, a good digital library means something different to different users depending upon their information need and background.

Saracevic and Covi (2000)\textsuperscript{48} examined the usability problem for digital libraries, traditional libraries are all organised in a similar way and if you can use one library you can use another regardless of geographical location (language barriers aside). This highlights the need for standards to be developed in the design of digital libraries to gain “uniformity for access and use”. They suggest that through the creation of an evaluation framework like their conceptual framework it may be possible to highlight common usability problems, in fixing them some standards will be established.

Sadagopan (2000)\textsuperscript{49} analysed that the availability of information at the fingertips but questions, where is knowledge. Digital libraries in the Indian context are discussed and highlights the opportunities available to library scientists for creating and accessing content in Indian languages.
Chen and Houston (1999)\textsuperscript{50} emphasise the four components that should reside in the digital library such as “Creating digital library content”, “Including and filtering information”, “Supporting universal access” and “Preservation”.

2.3 DIGITAL MATERIALS

Perrault and Anne Marie (2010)\textsuperscript{51} discussed about educational digital libraries offer a comprehensive collection of curriculum resources and formats that support learning. These resources maybe in audio, video, print, digital or interactive formats that can be used in adapting science activities for students with special needs. In fact, the multimodal resources offered by digital libraries are breaking down barriers and facilitating learning.

A digital collection department was created within the systems department of the library. Northam (2010)\textsuperscript{52} examined the growing pains experienced by the library, it has reaped considerable dividends from the digitisation efforts. The digital collections have provided an excellent opportunity for the library to collaborate with other libraries and organisations. In addition, the library bought more equipment including laptops, digital video cameras and external hard drives for additional storage space.

Breeding (2010)\textsuperscript{53} stated that more and more libraries are resorting to electronic collections, with the degree of shift that has already taken place varying from one type of library to another. While the proportions of formats that will constitute public libraries in the future are not easy to predict, the growing shift toward electronic content is expected to continue well into the future even as printed materials remain a significant offering of libraries. This transition toward more digital collections has important implications for the technologies needed to support libraries. Libraries are advised to avoid technologies that will cast their electronic offerings with the mold of today’s assumptions, and instead adopt those that are versatile.
Caplan (2008)\textsuperscript{54} study aims to find out the access to digital materials over time. Materials to be preserved must be assessed, selected and brought under the control of the custodial institution. Descriptive metadata, including persistent identifiers, must be created or captured. Also, it may be necessary to provide documentation to ensure that content will be understandable in the future. Digital files must be protected against unauthorised changes and physical storage media must be monitored to avoid deterioration and obsolescence. Finally, actions must be taken to ensure that digital materials remain renderable (displayable, playable, or otherwise usable) as today's file formats become obsolete over time.

Dujardin (2008)\textsuperscript{55} in his paper, seeks to examine the libraries and institutions are doing their best to digitalise every document in order to prevail it, in the music business 96% of everything created in the 20th century is still out of reach. The frightening scenario is that music libraries will turn in to music graveyards, including only material from musicians who have been dead for at least 70 years.

Caldera-Serrano (2008)\textsuperscript{56} focused on the management of audio visual documentation and those that can be forecast in the future as a result of the migration from analogue to digital information. For this purpose the documentary chain will be used as a basis to analyse individually the tasks that are more significantly affected by this documentary and technological revolution. Although the management of television audio visual information and the changes in ordinary documentation activities, the results may also be applied to other institutions working with the moving image. Automatic classification, automatic indexing, voice and video recognition and automatic generation of thesauri are some of the elements considered as potential or feasible methods to deal with and understand the information management activity of television channels.

Kaur (2007)\textsuperscript{57} stats that the cultural and heritage materials are being converted into digitised forms to provide immediate accessibility anywhere in the world. But due to obsolescence of formats, hardware, software and carriers, digital
information will be lost unless we act. Therefore preservation of digital materials for the benefit of present and future generations is an urgent issue to address.

McCracken (2007)\textsuperscript{58} have made an attempt to know the traditional description and access of library materials has undergone a transition for over a decade, librarians as well as information and computer scientists have worked with the challenges to identify and provide access to various types of digital resources such as electronic journals; electronic books and reference resources; electronic government publications, Web sites and databases; and geospatial maps and digitised special collections. Along with the provision of measures to internationalise and accommodate the nature of electronic resources (ER). The goal is to continue to identify, manage, and preserve digital materials today and into the future in order to provide the best access to information for library users.

McDonough and Jimenez (2007)\textsuperscript{59} reviewed that the digital library community is increasingly concerned with long term preservation of digital materials. This concern presents an opportunity for strategic alliances between digital library units and preservation departments confronting the difficulties inherent in preservation reformatting of moving image materials. However, successful collaboration between digital library and preservation departments may require adjustments to the work practices of each group, including their creation and management of metadata and their definition of acceptable practice with respect to preservation reformatting.

Agirreazaldegi-Berriozabal (2007)\textsuperscript{60} analysed that the television is becoming digital, as are TV archives and archival research. Digitisation of previously archived footage is a slow, expensive process that requires significant public funding. This fact, together with new technological developments, favors the opening of major archives to the general public for TV stations, digitising and media asset management systems offer new tools and generate a new work environment, both for reporters and archival research.
Nagatsuka and Kando (2006)\textsuperscript{61} in is study the digitalisation of information sources such as books or audio/visual media of the library holdings is an activity undertaken by many developers of digital library. Many of the digital content created by the developers are made available as part of the Web. The volume and types of digital content are rapidly increasing now. The development of information technology such as Internet and Web is affecting the activities of traditional library.

Jayawardana et al (2001)\textsuperscript{62} has investigated the active learning of individual users can be supported in the personalised information environment of a digital library. With respect to digital materials, three main facilities are required when active learning tools are designed and developed, namely, active consuming, information gathering and information seeking. The architecture of a personalised information environment is divided into two schemas called collection personalisation and material personalisation. Those tools are designed, developed and used to access digital text, audio and video materials.

\section{2.4 ONLINE RESOURCES}

Information users face increasing amounts of digital content, some of which is held in digital library collections. Parandjuk (2010)\textsuperscript{63} undertook the study in academic librarians have the dual challenge of organising online library content and instructing users in how to find, evaluate and use digital information. Information architecture supports evolving library services by bringing best practice principles to digital collection development. Information architects organise content with a user centered, customer oriented approach that benefits library users in resource discovery.

Cornish and Merrill (2010)\textsuperscript{64} stated that the large scale book digitisation projects, research libraries will increasingly be distinguished by their special and unique collections. Digital documents and digital objects (derived from photographs, manuscripts, and other special collection items) to be published online. While several significant market and technological challenges exist, there are available
solutions, both commercial and open source, that enable libraries to publish selected digital collections and items online.

Digital libraries and the development of educational, scientific and cultural heritage institutions with significant commitments to online resources and online services. Vignesh (2009)\textsuperscript{65} discusses the future of the digital library is a topic of continuing concern for the library professionals. Though we face more constraints and technology problems let us look into what means might be round to break open those constraints and encourage visions projected further into the future and challenge the assumptions about digital libraries that are so deeply rooted in our thinking by stimulating a creative agenda for the next generation of digital library.

Skekel (2008)\textsuperscript{66} surveyed the numbers of digital collections being produced by academic, public and special libraries, these endeavors represent a new direction. Libraries engaged in initiating, implementing and maintaining digital collections are expanding their traditional roles of collecting, organising and providing access to resources. Their new roles include creating content and in some ways, also creating the access. Libraries are involved in the "business" of producing digital collections a task made possible and also easier by the technology developed and available, but a task often begun with scant initial funding and achieved by "converting" staff members already dedicated to other tasks at the institution.

Blummer (2007)\textsuperscript{67} in his study beginning in the late 1990s, technological developments coupled with new digitisation efforts offered new opportunities for websites with commercial and local databases, electronic journals, e-books and virtual reference. The availability of new content and services on library websites facilitated research efforts comparing these features among academic library websites. During this period, articles also emerged that considered navigation and usability issues for these pages. The literature on academic library web pages documents efforts by libraries to use web technologies and resources to serve user groups.
McCracken (2007)\textsuperscript{68} stats that the traditional description and access of library materials has undergone a transition for over a decade, librarians as well as information and computer scientists have worked with the challenges to identify and provide access to various types of digital resources such as electronic journals; electronic books and reference resources; electronic government publications, Web sites and databases; and geospatial maps and digitised special collections. Along with the provision of measures to internationalise and accommodate the nature of electronic resources (ER) the goal is to continue to identify, manage and preserve digital materials today and into the future in order to provide the best access to information for library users.

Fortini (2007)\textsuperscript{69} under taken the study on academic libraries are increasing the number of electronic journals (e-journals) in their collections. While patrons enjoy access to articles with the click of a button, librarians face the complex process of implementing and maintaining e-journal subscriptions. The problems and concerns that arise during an e-journal project, the issues that persist throughout e-journal acquisition and management and the phases in which these problems arise. Librarians considering a switch to electronic access must be prepared to face continuing problems with access, archiving, cost, staffing/workflow and technology.

Sharifabadi (2006)\textsuperscript{70} has investigated the digital libraries complement other learning environments, such as those provided in distance education and courses offered online. Like e-learning environments, they provide flexibility of time and place. Digital libraries have the potential to offer unprecedented resources to support e-learning. Access to current research and needed information within a well developed infrastructure can provide faculty members and students with a unique opportunity to carry out deep research and to teach and learn more thoroughly.

Digital Library has been created to provide access to all digital and digitised offline and online resources, online e-journals, electronic documents and virtual resources and virtual libraries. Deb (2006)\textsuperscript{71} discusses the purpose of the integrated library is to provide a single window to researchers, through which they can access all the resources (both digitally born resources and digitised documents). Once users
are able to access the digital library homepage, all the electronic resources are accessible using linkages with a single click, no matter whether they are available in a database or as a simple file in a virtual collection.

Krishnamurthy (2005)\textsuperscript{72} discussed to create true digital libraries, not just digital collections, will require librarians to work closely together to create open, distributed, publicly accessible resources, as well as to establish a collaborative structure to coordinate and guide implementation. Interestingly, the digital library seems to be digital collections of consortia based e-resources, OPAC and CD ROM databases.

Schmetzke (2005)\textsuperscript{73} examined that the formatting and implementing policies to ensure barrier free access to all online resources to remedy the present situation in which librarians seem to neglect the question of accessibility when procuring databases or designing digitisation projects. Describes how a web accessibility task force at created a new online accessibility policy and the benefits which resulted from its implementation.

Munshi (2003)\textsuperscript{74} points out in his article that the growing acceptance of digital media has resulted in libraries buying and providing access to Internet resources, acquiring CD ROM based data sets and providing services for standalone or networked CD ROMs environments and digitising documents.

2.5 DIGITAL LIBRARY HARDWARE AND SOFTWARE

Biswa and Paul (2010)\textsuperscript{75} analysed that the digital Library open source software has helped spread the practical impact of digital library technology throughout the world, with particular emphasis on developing countries. As dSpace and Greenstone enters its second decade, the challenges that have been faced and the lessons that have been learned in developing and deploying a comprehensive open source system for the construction of digital libraries internationally. Open source digital library packages are gaining popularity nowadays. To build a digital library under economical conditions open source software is preferable.
Hassanzadeh and Paknejad (2009)\textsuperscript{76} says that a scarcity of research on introducing and assessing software related to digital libraries. Worldwide efforts have been made to develop digital library software. The Greenstone digital library software was prepared and designed. As an open source program and it could be downloaded for free from the internet. This software can open new windows to libraries for developing and managing digital libraries.

Mittal and Mahesh (2008)\textsuperscript{77} examines the digital libraries and repositories were explored to study their collections. Use of open source software especially for the creation of institutional repositories is found to be common. However, major digital library initiatives such as the digital library of India use custom made software. The collection size in most digital libraries and repositories is in a few hundreds.

Breeding (2008)\textsuperscript{78} highlights the library automation arena in the last couple of years involves the development of a new generation of interfaces to replace online catalogs that have fallen behind the expectations of web savvy library users. This aspect of library automation currently attracts incredible interest; almost all libraries are giving consideration to how they can bring the search tools they offer for their collections as well as their overall web presence up to the level expected today. Even at this early point in the adoption cycle of new library interfaces, it is time to press onward toward even more effective and powerful search tools.

DeRidder (2007)\textsuperscript{79} stats that the software for digital libraries impacts usability, interoperability, support costs and the ability to migrate materials over time. Intelligent selection requires careful assessment of internal needs and resources, as well as careful assessment of the options. Other considerations may be preferences related to the goals of your library, such as support of metadata standards, interoperability with other systems and additional functionality.

Zargarayan (2007)\textsuperscript{80} suggest that the history of library automation, from its beginnings and describes the evolution and challenges faced by the library community on its difficult way to digitisation. The history of automation and
computerisation of libraries has developed through 15 years a short time as measured by humans. An independent state faced a political and economic crisis, moved from a centralised economy management system to a market based economy. Libraries are also in a renovation and cardinal reconstruction process.

Kaczmarek et.al (2006)\(^{81}\) says that the digital library initiatives have encouraged the development and implementation of repository software applications such as DSpace, Eprints and Greenstone. These applications are being commonly deployed within the context of institutional or digital repositories. As the boundaries of, and landscapes around, institutional or digital repositories become more clearly defined and expressed, there is a greater need to have useful methods for evaluating repository software applications and the role they play in the broader context of repository services.

Weber (2006)\(^{82}\) in his study the digital library software is facilitating the task of creating a digital library, once the preserve of big research libraries with large staffs and budgets, and providing the means by which smaller libraries can produce "do it yourself" digital libraries. Many of the commercial digital library software products were designed to provide other functions, such as blogs and content management systems, but which were found to be capable of being extended and adapted for use in producing digital libraries.

Lucas (2006)\(^{83}\) discusses the greenstone suite of software for building and managing digital library collections and for distributing them on the World Wide Web (WWW) or on CD ROM. Like other important digital library tools, such as DSpace and Fedora, Greenstone is an open source development and the software is designed and written by a community of developers. The software is frequently updated with improvements and fixes; the source code is freely accessible, making possible extensive customisation with plugins; and the software is available to download.

Use of open source software implies freedom and flexibility for libraries. Fox (2006)\(^{84}\) discusses the open access publishing and open standards for metadata
and protocols, they take a more active role in the testing and development of open source software. The open initiatives are motivation for libraries to be more actively involved in the open source movement as an extension of traditional librarianship and as an enhancement to the digital projects and services.

Cervone (2006)\(^{85}\) the study reported the digital library system software selection differs in some significant ways from traditional software implementations. In particular, security and authentication issues, long term cost and maintenance considerations, vendor viability, as well as training and documentation are areas where the software selection needs to devote greater attention if the project is to be successful.

Gupta and Singh (2006)\(^{86}\) Says that once the digital library has been created, its management is important. The issues and strategies involved in management of digital libraries include hardware management, software management, collection management, preservation/archiving, financial management and the access system are focused.

Witten and Bainbridge (2005)\(^{87}\) discuss the greenstone digital library software is a comprehensive system for building and distributing digital library collections. It provides a way of organising information based on metadata and publishing it on the Internet or on removable media such as CD ROM/DVD. First time users can easily and quickly create their own digital library collections. Advanced users can design and customise new collection structures, create new collections whose structure mirrors existing ones and build collections and put them in place for users to view.

Witten (2003)\(^{88}\) says that the building and distributing digital library collections, opening up new possibilities for organising information and making it available over the Internet or on CD ROM. Greenstone digital library software is intended to lower the bar for construction of practical digital libraries, yet at the same time leave a great deal of flexibility in the hands of the user.
Witten et al. (2001)\textsuperscript{89} analysed that the greenstone digital library software is an open source system for the construction and presentation of information collections. It builds collections with effective full text searching and metadata based browsing facilities that are attractive and easy to use. Moreover, they are easily maintained and can be augmented and rebuilt entirely automatically. Greenstone incorporates an interface that makes it easy for people to create their own library collections. End users can easily build new collections styled after existing ones from material on the web or from their local files (or both) and collections can be updated and new ones brought online at any time.

2.6 \textbf{DIGITAL LIBRARY ACCESS / ARCHITECTURE}

Sheeja (2010)\textsuperscript{90} describes the frequently access the digital library for getting previous exam question papers, syllabi and other materials pertaining to their study. They are satisfied with current digital library features and functionality. Students recommended the addition of more documents related to their courses and useful links to the digital library.

Hwang et al (2010)\textsuperscript{91} suggested that indexing remains one of the most popular tools provided by digital libraries to help users identify and understand the characteristics of the information they need. Despite extensive studies of the problem of automatic index construction for text based digital libraries, the construction of multimedia digital libraries continues to represent a challenge, because multimedia objects usually lack sufficient text information to ensure reliable index learning.

Berard (2010)\textsuperscript{92} state that the redesigned IEEE Xplore 2010 digital library boasts an improved interface to go with deeper search options, expanded browsability, and the latest technology tools for both inexperienced and advanced researchers. The revamped database offers full text access to more than two million documents in the technology fields dating from 1988 to the present and delivers content such as articles from the most highly cited journals, conference proceedings and industry standards.
Innocenti (2010) discussed a interoperability is a property referring to the ability of systems and organisations to work together. Today interoperability is recognised as a key step in the shift from isolated digital libraries toward a common information space that will allow users to browse through different digital libraries within a single integrated environment.

Pilsk et al. (2010) state that the open access digital library of taxonomic literature, forming a single point of access to this collection for use by a worldwide audience of professional taxonomists, as well as "citizen scientists." A successful mass scanning digitisation program, one that creates functional and findable digital objects, requires thoughtful metadata workflow that parallels the workflow of the physical items from shelf to scanner.

Meng-xing et al (2010) highlights the advanced management model for a digital library which can have the advantages of google, other search engines and libraries, yet avoid their inherent weakness. For that, the paper investigates and analyses the advantages and weaknesses of google and digital libraries at home and abroad and makes reference to the theory of supply chain management to construct a new management model for a digital library.

The integration of digital library technologies with ontology based knowledge representation in providing semantic rich information access in e-learning. He et al (2010) explains the digital library technologies have powerful and flexible content management and access functionalities, whereas ontology helps teachers and students to link content materials to their learning objectives.

Eschenfelder and Agnew (2010) says that the use of digital cultural materials made accessible by U.S. archives, libraries and museums. Libraries reported using a broader range of systems than archives or museums including repository software, streaming media servers, digital library software and courseware.
Hassanzadeh and Paknejad (2009)\textsuperscript{98} greenstone digital library software can open new windows to librarians for developing and managing digital libraries, these introduce the open source software to librarians and experts and on the other hand it could present a new research route in this field to experts and enthusiasts.

Hafezi and Karimi (2008)\textsuperscript{99} examined that the process of designing a digital library begins with system analysis and continues with architectural design and programming. It then ends up with examination and installation and support of the final product as a new born digital library. Development of architectures of software begins with the plain architecture of the server, which is of the primitive generations of software design and continues, with complex 3-layer client/server kind of architecture.

Das et al (2007)\textsuperscript{100} analysed the present situation in the development of indigenous digital libraries focusing on the retrieval features of digital libraries in India. Its shows that information retrieval features of digital libraries vary significantly from each other due to the use of different content organisation techniques and differing types of digital content.

San Jos (2006)\textsuperscript{101} explores the changing needs of architectural archives focusing on the challenges posed by the digitisation of traditional objects in architectural collections and the technical obstacles in preserving born digital records. The development of strategies for documenting architectural records, explores the benefits of digitising collections. The impact of technological developments on archival training surveys the contribution of architects to the preservation of digital records and describes the continuing collaboration between archivists and architects to ensure the preservation of architectural archives.

Manduca et.al (2006)\textsuperscript{102} under look a study on educational digital libraries are grounded on the premise that educators can do a better job with less effort if they can easily find and reuse materials that are created by others. In this model, success is predicated on the ability of the digital library to engage its community in building relevant and useful collections and in using these resources to enhance teaching.
Arumugam (2005) discuss about the concept of data mining and certain algorithms than can mine frequent user access patterns of the library database. Though the title of the article states that it is about discovering frequent access patterns in a digital library using association mining.

### 2.7 DIGITISATION

Digitisation projects are also being launched in academic, research and public libraries. Breeding (2010) discusses the unique and special collections in the custody of libraries are expected to survive well into the future. Trusted digital repositories implement the best practices available to ensure that print documents are transformed into digital content. The Open Archival Information Systems (OAIS) is a classic example of how best practices help to ensure the long term digital preservation of cultural heritage.

Kowal and Rhatigan (2010) described the access to cartographic images via digitisation and maintaining the integrity and authenticity of the digital objects and associated metadata, is a current preoccupation of map curators. Format specific information about the complete digitisation process can aid in planning for scanning projects to ensure reliable access, active management and long term preservation.

Capell (2010) in their study digitisation is widely recognised as an access tool for archival materials, but it is not universally accepted as a preservation method. In certain cases, however, digitisation is the most feasible option for recovering and preserving content. Acetate photographic negatives are a case in point. Deteriorated negatives off gas acetic acid resulting in warping and shrinkage that can cause severe damage. It can be difficult and expensive to salvage the information content of the images using traditional photographic methods.

Amberg (2010) discussed that digitisation is considered as "reproduction" according to copyright terminology, because digitisation is but transforming analogue works into digital ones, by copying as necessary. Library digitisation serves a dual aim preservation and document provision (availability).
Jin (2010)\textsuperscript{108} says that digital objects have extensively existed in daily work and life. Some of them often need to be kept accessible and usable for a relatively long period of time. Therefore, digital preservation has emerged as a pressing demand for the communities of archives, libraries, publishers and even for ordinary computer users. However, compared to traditional papery and magnetic preservation, digital preservation poses novel challenges to these communities.

McLeod and Shipman (2010)\textsuperscript{109} explains the electronic preservation of a document has been successful, one might have to wait many years. Success is attained when the electronic document can be located, the media upon which the document has been stored can be read, software is available to access the file format and one can confidently create an accurate representation of the original document.

Hedberg (2010)\textsuperscript{110} stated that, the digital preservation, which shows how digital materials can be preserved indefinitely at a low cost through replication and distribution. Planets preservation and long term access through networked services has published. The digital divide assessing organisations preparations for digital preservation, a white paper that assesses the current capabilities and future expectations of 200 international organisations for preserving digital content.

Breeding (2010)\textsuperscript{111} in his study, the digitisation initiatives are proliferating all around the world. Most libraries are now trying to digitise and preserve their collections including photographs, manuscripts and other unique content. Digitisation projects are also being launched in academic, research and public libraries. Trusted digital repositories implement the best practices available to ensure that print documents are transformed into digital content. The Open Archival Information Systems (OAIS) is a classic example of how best practices help to ensure the long term digital preservation of cultural heritage materials.

Conway (2010)\textsuperscript{112} says that, the digitisation practice in archives and libraries is now generating digital content and associated tools and practices that are transforming the relationships among archivists, users and archival collections. The
transformative nature of digitisation derives in part from the power of the complex technologies to represent images and facilitate their use.

Kowal (2010)\textsuperscript{113} explaining about creating access to cartographic images via digitisation and maintaining the integrity and authenticity of the digital objects and associated metadata, is a current preoccupation of map curators. Format specific information about the complete digitisation process can aid in planning for scanning projects to ensure reliable access, active management and long term preservation. The outcome is a unique application of existing library standards and systems and illustrates an alternative to project specific software programs or web pages for managing and providing access to digitised collection materials.

The implications of Large Scale Digitisation Initiatives (LSDIs) for our programs Rieger (2010)\textsuperscript{114} discuses that the LSDI efforts thus far have focused on general collections, it is inevitable that the attention will soon be turned to special collections. With the current networked information environment and increasing reliance on digital content subscriptions, rare and manuscript collections increasingly define the uniqueness and character of individual research libraries.

Matusiak and Munkhmandakh (2009)\textsuperscript{115} examined that the newspaper digitisation poses many challenges due to large format, complex page layout and poor quality print. These difficulties are compounded in the development of international digital libraries that use non Latin characters. Greenstone, in open source digital library software suite, offers multilingual support and was used to create a digital archive of rare publications.

Bansode (2008)\textsuperscript{116} analysed that, the digitisation of rare materials in one Indian university. Digitisation is the solution for the preservation of, and access to, rare manuscripts the development of digital libraries in India. It is useful for setting the infrastructure required for digitisation and a guideline for preservation and access to the rare materials.
Bradley (2007)\textsuperscript{117} remarks “Clearly it is not possible to preserve digital information without a sustainable organisational, economic, social, structural and technical infrastructure, nor is it sensible to preserve material without sustained value.

Varatharajan and Chandrashekara (2007)\textsuperscript{118} discusses that digitisation play an important role in preserving and disseminating knowledge in art and culture, education, science and technology, literature and humanities, media and entertainment, cultural heritage and history. In India, a substantial number of libraries and information centres have initiated digital library activities. Indian society has created and preserved the resources of traditional and cultural heritage in various forms; however, thousands of ancient books and manuscripts remain in perishable palm leaves and urgently need digitisation.

Sankar et al. (2006)\textsuperscript{119} says that starting from the selection of books for digitising, operating and establishing a protocol for being free from effort duplication, producing digital output of good quality and preservation of the digitised book objects for access in a user friendly, reliable and highly available manner.

Understanding one’s preservation cost structure is nonetheless paramount for managing sustainability issues. Curall and McKinney (2006)\textsuperscript{120} discuss that the costs influence incentives and incentives determine who will be willing to support preservation initiatives in both the short and long term. Likewise, gaining control over the structure of incentives can ensure more successful business models and funding structures. Few are willing to pay for a preservation initiative without knowing how much it costs and how the costs are distributed.

Giri (2006)\textsuperscript{121} investigated that, the digitisation reduces the gap between the documents and its users. One of the prominent characters of digital library is its frankness or openness in the arrangement of data. Digital information which is kept in a website can be equally accessed by all its users. Every library of excellence has
a hybrid nature in which both the digitised documents are coexisted with the vast resources of non digitised documents.

Ambati et al (2005)\textsuperscript{122} says that, the digitised content returned from the contractors and approves for uploading and hosting on the web. They perform the check for duplicates, improper scans, damaged pages, missing pages, file formats and a few other parameters to ensure that the quality standards defined in the DLI are met. Administrative issues regarding the decision making of the undefined errors found in the digitised books and content is also made by this team. The team also ensures the process is carried out in the defined manner and performs process audits for applying the improvement strategies.

Ramesh Babu (2005)\textsuperscript{123} the fast developments and spread of information technology has initiated several projects and programmes all over the world to build large-scale digital depositories, especially for the preservation of culture and national heritage. Libraries and museums have been considered as important centers of such activities. Intensely pursued area in digitization activity resulted in the development of digital repositories of rare texts, manuscripts, images, paintings and articrafts. Indian tradition, culture and heritage are well known everywhere. Indian heritage treasure consists of wisdom, thoughts, entertainment, philosophy which is fascinating and long lasting.

Gulati (2004)\textsuperscript{124} discussed about the Indian scenario on the use of ICT infrastructure in libraries and information centres depicts that special libraries are better equipped and are involved in consortia and digitisation programmes in the country.

Ingo et al (2004)\textsuperscript{125} says that, the assembling the data and making it available for easy access is one of the most important phases of any digitisation project. Each Mega scanning centre is responsible for gathering the metadata and the scanned content from the contractors operating at its scanning locations. This data is to be enabled on the web and also preserved for future. Enabling many tera bytes of data
for access to everyone in a highly reliable manner is needed for the success of the efforts put into the digitisation process.

Bainbridge (2003)\textsuperscript{126} says that, the digital Libraries have received wide attention in the recent years allowing access to digital information from anywhere across the world. They have become widely accepted and even preferred information sources in areas of education, science and others. The rapid growth of internet and the increasing interest in development of digital library related technologies and collections helped accelerate the digitisation of printed documents in the past few years.

2.8 INFERENCES ON THE REVIEW OF LITERATURE

From the above literature review the following inferences could be drawn.

i. A total of 126 publications comprising of journals articles, conference proceedings and abstracting databases have been reviewed representing most of the recent decade publications.

ii. The review has been broadly grouped under 6 headings such as

1. Digital Library
2. Digital materials
3. Online resources
4. Digital library hardware and Software
5. Digital library access/architecture
6. Digitisation

iii. The publication mostly represents foreign authors and Indian authors covered to a greater extent.

iv. These studies represent mostly on digital library and online resources in the university level libraries of Tamil Nadu.
v. Most of the studies concentrate on digital library, digital library initiatives and digitisation and so on.

vi. There are no study on digital library infrastructure and facilities in the university libraries in Tamil Nadu.

vii. Further there is no study on digital library infrastructure and facilities in the university libraries either in India in general or Tamil Nadu in particular.

viii. This study bridges the gap in the literature and therefore makes comprehensive study of digital library infrastructure and facilities in the university libraries in Tamil Nadu.

In the next chapter an overview of growth and development of higher education and State-of-the-art of university libraries in Tamil Nadu is provided.
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