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LIS Perspective on Multimedia Information Retrieval Techniques: A Critical Analysis

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Abstract

Multimedia information retrieval (MIR) ongoing research challenge for the domain of computer science, electronics, and Library & Information Science (LIS). The content-based retrieval of multimedia information is active research in computer science for the last decade. LIS domain is slowly moving away from MIR research and becoming an end user to use the tools and theories generated by computer science. The present paper brief discusses the various components and classifications of the MIR. It discusses analytically LIS perspective on text, image, audio and video information techniques. Finally, it suggested a research gap in MIR where LIS domain seriously contributed in developing and upgrading existing applications.

Keywords: MIR, LIS, Library & Information Science, Image Retrieval, Audio Retrieval, Video Retrieval,

Library of Congress Classification No: CCS – H.3.3

1. INTRODUCTION

The field of information retrieval (IR) has been active for several decades. Initially, the field focused on efficient and effective analysis of information needs expressed by a set of keywords. This model is still continued (e.g., search engines). Large quantities of information are available in multimedia formats, including video, audio, and images. There is an increasing amount of multimedia resources available through a combination of a growing interest among users as well as the development of new technologies enabling universal access to these resources. The research field of Multimedia Information Retrieval (MIR) investigates effective and efficient ways of processing queries involving multimedia objects. The main challenge here is to provide "retrieval by content", i.e., to provide results not only based on the metadata or textual descriptions of objects but also based on the content of those objects.

With the rapid development of multimedia technologies and the proliferation of multimedia content, the importance of MIR has grown dramatically. Increasing demands on the level of sophistication of MIR solutions have been imposed by users seeking semantically rich, personalized and context-aware

solutions for access to multimedia content. Over the past twenty years there has been a growth in interest in developing MIR technology that can meet such high demands using intensive international research efforts. Today, with the increasing explosion of multimedia information, finding information of interest has become extremely difficult. The majority of this information must be retrieved at a later date, by people other than those who generate it, and with less effort than is necessary for a manual search.

2. MOTIVATION FOR THE STUDY

A total of 9345 articles were published and indexed between 1975 to 2021 on Multimedia Information Retrieval according to Scopus report and Fig 1 represents the subject-wise distribution of MIR publication (Elsevier, 2022). 70% of the articles were published in the computer science and engineering domain. The contribution of the LIS domain into MIR does not exist in a separate discipline. In addition, contributions from the LIS domain include in arts & humanities, social sciences and other categories. This lacuna motivates to undertake a study on critical evaluation of MIR in the Library & Information Science perspective.

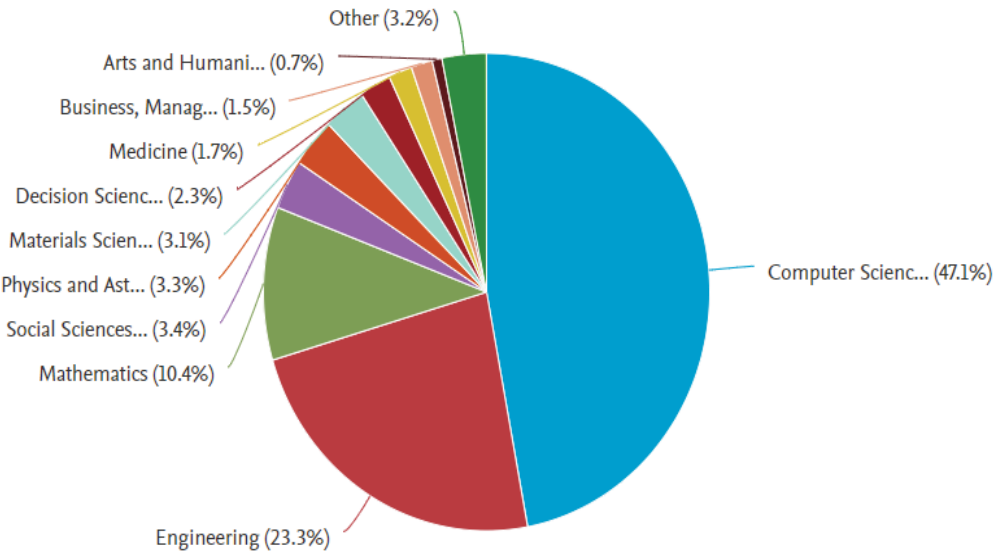

Fig. 1 Represents the subject-wise distribution of MIR publication

3. COMPONENTS OF MULTIMEDIA INFORMATION RETRIEVAL

3.1. Text Retrieval Techniques

A user-centric information retrieval system (IRS) retrieves documents and information based on the information requirements of the user community. By providing the right information at the right time to the right user, it aims to make sure that the right information is available. Information retrieval is concerned with representing, searching for, and manipulating large collections of textual data. Research

in information retrieval deals with retrieving unstructured or partially structured data, particularly textual documents, in response to a set of queries or topic statements, which can themselves be unstructured. A system based on IR does not inform, that is, change a user's knowledge about the subject of his inquiry; instead, it simply informs him of the existence, nonexistence, and location of relevant documents.

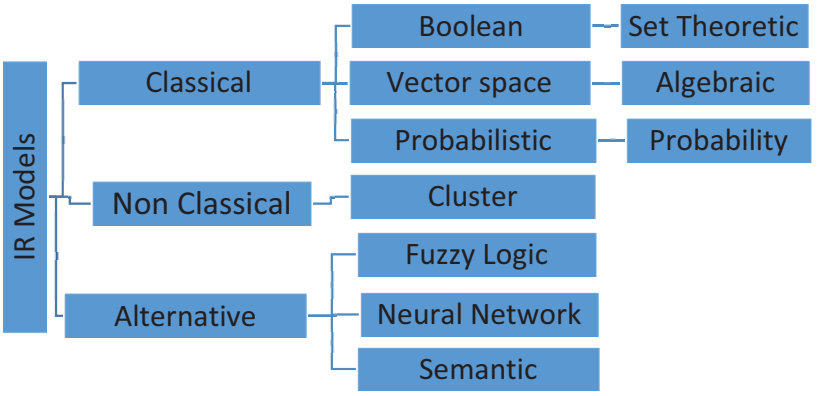

Fig. 2 Different types of Information Retrieval Model

Fig 2 shows different types of information retrieval models. The Boolean model is the oldest and set of theories which the majority of search engines use till now. A suitable representation of the multimedia documents is generally required in order to effectively retrieve relevant information through retrieval strategies. The multimedia document-representation used by each retrieval strategy is based on a specific model.

3.1.1. LIS perspective

The retrieval term literally originated in old French and widespread in the Library Science domain. The retrieval term referred to the early days of the library profession to find and discover the document in the library. The card catalogue is the tool for document retrieval in the library. This concept was a takeover by the computer science domain developed search engine tool to locate information over the internet. Since then information retrieval has become an active research area of the computer science domain and the Library Science domain has become an active user to use these tools to provide services to end-users.

The LIS domain adopted the theoretical part of the different types of IR modules (as shown in Fig.1) in the teaching process in all the levels of the UG-PG program. The Conferences, Seminars and symposiums were organized frequently by the library science professionals to know the latest happening in the multimedia information retrieval domain. The encouragement to pursue research in the topic of MIR in the LIS domain is very minimal, especially in the Indian scenario.

The LIS applications for automating libraries and maintaining the repositories are using classical IR techniques. The popular commercial players and open sources applications of Library automation and

Institutional Repository still use classical Boolean techniques to retrieve the records from the database. These applications are very much limited to searching the metadata and human annotations and have no provision to search full text from the application. The commercial and Open-source digital library application developers are not keen on the retrieval part of the document stored in repositories and they are interested in storage and organizing the document to retrieve by browsing systematically.

In the early 21st century, the commercial publisher came up with the electronic version of Books and Journals along with the digitized version of the back volume of these journals and provided searching for the full-text content from the collection. The commercial publisher uses alternative Information retrieval techniques to retrieve the information from the large database within a few seconds.

3.2. Image Retrieval Techniques

A computer technique for exploring, searching, and retrieving images from a large database of digital i mages is known as image retrieval(Ang et al., 2021). Image processing and image analysis are very active research in the domain of computer science and electronic communication. The accessibility and availability of digital image capturing devices like digital cameras, image scanners, and the dimensions of digital image assortment are increasing speedily. Fig 3 shows the various domains that uses image retrieval techniques for searching for innovative ideas, design, past events etc.

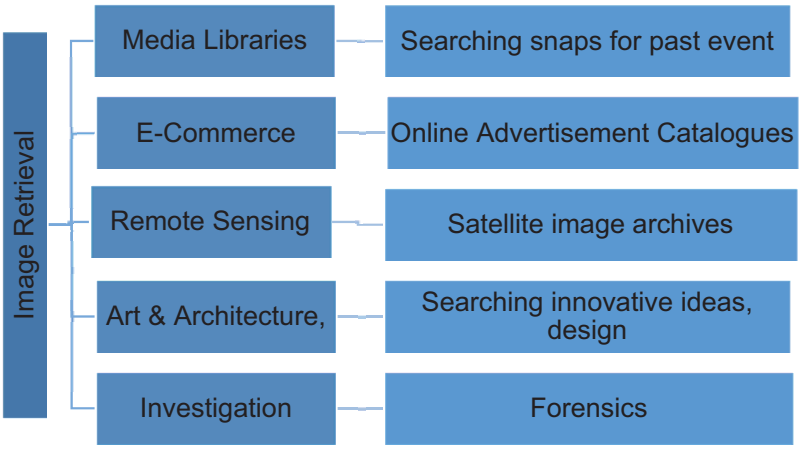

Fig 3 shows the instances of image retrieval by various domains.

Fig 4 presented two types of image retrieval techniques, particularly text-based image retrieval and content-based image retrieval techniques. A text-based image retrieval uses keywords contained within the name or in the description of the image, while a content-based image retrieval finds images by the content, which can include color, size, texture, or the objects that appear within the image(Adrakatti et al., 2016). It'll search by uploading a picture or unified resource locator (URL) of a picture already on

the web. The search engines that used the CBIR techniques are referred to as Reverse Image Search Engines. Popular search engines are allowed to search by image as inputs.

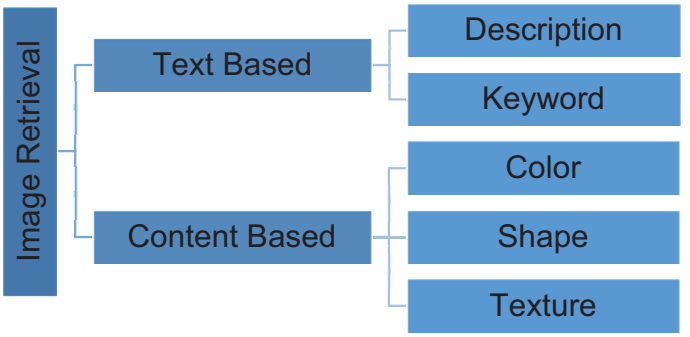

Fig 4 shows the different types of Image retrieval techniques

3.2.1. LIS Perspectives

Print media libraries use image retrieval techniques on a daily basis to search large repositories for past events. The media libraries are using commercial applications to organize the archive of past articles, issues, and snaps in image format. The search functionality of this application is limited to metadata, tags, and annotation. Library professionals who work in media libraries are finding it difficult to retrieve the desired image from these repositories. The commercial applications are not supporting content-based image retrieval techniques to find the images.

The available popular open source Institutional Repositories allow to collect, store, organize the images into a database, and search term is restricted to the metadata of images. The human annotation and metadata of images cannot be described in limited words as an image speaks of a thousand words. Since the popular search engines are already adopted content-based retrieval techniques to retrieve images from the internet. Its high time for LIS applications to incorporate content-based techniques to find the image based on color, shape, texture not limited to metadata.

3.3. Audio Retrieval Techniques

The audio data may consist of speech, music, or a combination of both. Audio data are typically searched and retrieved in a linear manner because of the fact that the audio signal is inherently one-dimensional and associated with time. To be able to use a content-based retrieval system for audio based on segmentation and indexation, first need to segment the audio stream. There is a continuum of audio events which feature distinct characteristics in their acoustic characteristics. When analysing and classifying single-speaker speech, music, multi-speaker speech, or even a speech accompanied by music, the appropriate feature space should be considered. The classification process then produces the partitioning of the audio stream required. When an audio stream is partitioned, each event can be stored and described individually by its unique characteristics. Then, indices can be created for each of

these events, and the user is able to perform content-based search and retrieval based on these indices.

Fig 5 represents the instances of audio retrieval techniques by different domains. Some of the commercial players are using the content-based audio retrieval technique for searching music and also called musical information retrieval. Some mobile applications use a voice search engine where the input voice and convert into text, the next process similar to traditional search engines. The

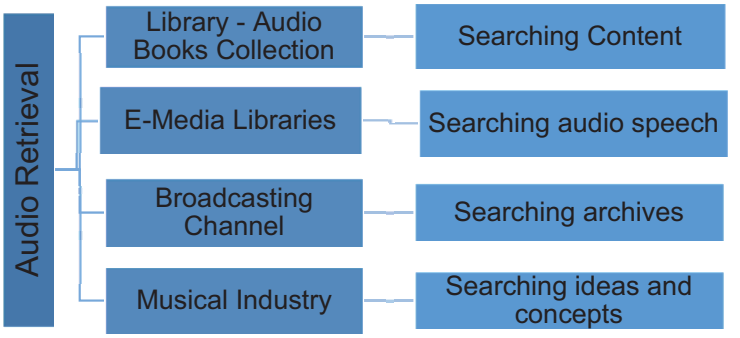

Fig 5. shows the instances of audio retrieval by various domains.

3.3.1. LIS Perspectives

The audiobooks are gaining popularity among the student community; subsequently the libraries are procuring the audiobook collection. Most of the public libraries access the audiobooks collection through subscription or perpetual mode. The aggregator provides a platform for the subscription of audiobooks to public and academic libraries. The search engine provided by these aggregators is restricted to bibliographic details only. Similarly, the electronic media libraries use the audio retrieval technique to search past speech in the database. The users are finding it difficult to find the required audio content from the large database. The popular audio management applications used by Media libraries and public libraries are not supported by content-based audio retrieval techniques and are limited to searching metadata on the audio clips.

The research into content-based audio retrieval is a neglected area in the LIS domain. The research experts are not showing interest and encouraging scholars to pursue research on audio retrieval. The LIS domain needs to find out the research gap in content-based audio retrieval to encourage researchers to start work on improving the precision rate.

3.4. Video Retrieval Techniques

The making of video is relatively easy with digital camera and mobile technology and easy to share them on social media and video-sharing sites. The 500 hours of video content uploaded on the popular

video sharing platform. The growth of video material available on the internet is generally combined with user-assigned tags or content descriptions to access the video (Smeaton et al., 2008). Video search refers to providing search capabilities for the entire archive of digital video content. Search features like these extract index able data from digital video content analysis results during the search process ("Encycl. Database Syst.," 2009). There is a huge amount of data involved in a video making it more difficult to extract the pertinent information; additionally, algorithms must be extremely efficient to be practical on large video databases due to this high amount of data. Video search must involve not only appearance, but also motion; videos include both visual and audible information; because videos are multimodal, there is a lot of information involved in both visual and audible modes (Jones & Shao, 2013). It is important to understand that offline steps dramatically speed up queries and deliver more relevant results.

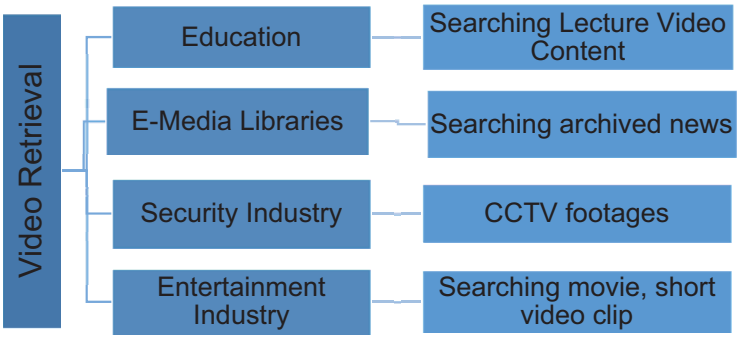

Fig 6 shows the instances of video retrieval by various domains.

3.4.1. LIS Perspective

The storage and retrieval of Lecture video content become a current challenge in the LIS domain. Due to the shortage of servers and low bandwidth of the internet, the vast majority of lecture video repositories and MOOCs are hosted on the YouTube platform and the web links are embedded in content management systems (CMS) and e-learning applications. Typically, these applications only search for metadata and human annotations associated with specific videos. Some applications lack search engines, and the SWAYAM platform is the best example of this. The user needs to browse the videos according to the subject on this platform.

A commercial video lecture application focuses only on recording and organizing video lectures based on their subject and topics. The retrieval of videos from repositories is the least concern and applications are neglected user concerns. The users do not find the desired information on the lecture video repositories and invest lots of time in browsing and listening to the videos to gain information. The popular open sources institutional repositories systems are limited to maintaining only document and image files. The retrieval is restricted to metadata and human annotations. These limitations and

restrictions were addressed by the research scholar of the LIS and started designing and developing lecture repositories with more focus on the retrieval of the videos based on the content from these videos.

4. CONCLUSIONS

A minute on the web in 2021 consists of more than 500 hours of content uploaded on a popular video-sharing platform, 695,000 stories shared on a popular photo and video-sharing platform (Lorri, 2022). The multimedia content is doubling roughly every two years. The fast growth of multimedia content has made research challenging in the computer sciences domain to make efficient servers to store content. The LIS domain needs to restart active research in automatic indexing, retrieval techniques in MIR. It must evaluate existing applications and theories available in indexing and retrieval; and come with an efficient system wherein the end-user must not waste a time in searching content on the large database. The computer science domain has less interaction with the end user and collects the comments randomly based on the anonymous feedback and build application. Therefore, many a time it may not fulfil the majority of the requirement and it leads endless efforts in meeting real expectations of the end-user.

The LIS professionals are better evaluators of these applications as professionals interact the end user closely and collect comments or relevant feedback and expectation; accordingly, the application needs to upgrade and theories need to be rebuilt.

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