HYBRID SYSTEM FOR MAP INDEXING ENHANCED THROUGH GIS

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Abstract

Indexing techniques during the earlier phases of their evolution relied entirely on the textual/ conceptual content for the purpose of treating conventional documents for the Index preparation. But with the changing times, the non-conventional documents, such as sound recordings, imageries, paintings, pictures, motion pictures, diagrams and maps etc. were inculcated in the collection maintained by the libraries. And in the modern society, they form integral part of any library collection. For the purpose of treating these non-textual documents, for the adequate storage and retrieval, fresh initiatives are required, preferably incorporating automated facilities. The present paper takes up the specific case of 'Maps', being a unique document with an ability to be auxiliary to every other discipline, in addition to that of the mother discipline i.e. Geography. But owing to the same very unique Characteristic, the Indexers face hazards while taking up the indexing of Maps. Since neither the Content nor the Concept based Indexing have been found to be absolutely suitable for the purpose. Therefore a feasibility study for a hybrid type of Indexing system has been attempted in the present paper. Beside the study explores the utility of Geographic Information System as a tool, which can further facilitate the preparation of an Index for a chunk of Maps.

Keywords: Hybrid Indexing System; Geographic Information System; Content-Based Indexing; Concept- Based Indexing; Maps.

1. Introduction

In today's Information Society, a Library & Information Center projects a combination of conventional as well as non-conventional sources of information. The experts working on various tools/techniques for Information Storage & Retrieval(IS&R) have worked rigorously on the conventional sources and successfully too, but the unconventional ones still ask for their keen attention. And for a unique unconventional document like Map undertaking the process of adequate storage & retrieval is a challenge in itself. The reigning complexities are due to it's difficult qualities i.e. of being factual, carrying scattered information, with non-contextual data, projecting information in symbolic language, and the facts being exhibited in the spatial context etc. Further, these qualities render the Maps, unsuitable for either the Concept or the Content based Indexing. Therefore the feasibility for a Hybrid Indexing System (HIS) especially designed for the purpose of Indexing Maps has to be explored. Besides the present exercise looks forward for the tools and techniques, which can further facilitate the process, both for the users as well as the Indexers, Such as Geographic Information Systems (GIS).

2.   Hybrid Indexing System for Maps : The Concept

As most of the sources of information are in textual version, the Concept Based Indexing (CCBI) system is implemented successfully to prepare the Index for the same, but in case of non-textual document like maps, the information born therein is in the non-contextual, coded, factual and scattered form, therefore the concepts is not explicitly stated . Thus the CCBI is found to be incompatible with the maps. On the other hand, many experimental studies being conducted, over a period of time, indicate that Content Based Indexing (CNBI) too, does not seem to be perfectly suitable for such type of documents. Therefore the indexer has to borrow the suitable aspects from both the Indexing Systems to develop a Hybrid type of Indexing System, especially designed for the unique characteristic of the Map as a source of information

3.   Hybrid Indexing for Maps : The Dimensions

Through HIS, it is feasible for the indexer to process various imagery features, such as color, shapes and texture etc., which are termed as low-level features [Lancaster, 2003]. In fact, there is no alternative way to interpret the images like Maps .The Maps Indexer, for the purpose would have to convert the information, which is already in symbolic version, into various icons. And the various icons can exhibit the map dimensions, such as.

- **Geomorphological :** Relief features ,ongoing geomorphological   processes ,operations, and factors;
- **Pedological :** Composition , distribution, utilization and formation of soil types;
- **Meteorological:** Prevailing and upcoming Weather/Climatic conditions;
- **Demographic:** Population related, structures, ratios, composition, distribution and the movements;
- **Urban/ Rural Settlement/s:** Settlements, their distribution, formation, structures and factors;
- **Political:** Political boundaries and practices;
- **Economic:** Economic activities bodies and operations;
- **Agricultural:** Crop conditions, distribution, production and related factors;
- **Anthropological :** Racial characteristics, distribution, structures, movements and the related facets; and
- **Cartographic :** Cartographic tools ,technique and related objects.

Thus the CNBI i.e. indexing of images by their intrinsic features, would be most suitable for Maps. And through the process of automated iconography the Map contents can further be enhanced. The icons can later be converted into standardized vocabulary i.e. concepts, to trigger the further process of proper Concept –Based Indexing, which is, word based descriptions of images, prepared by human [Rasmussen,1997]

4.   Hybrid Indexing for Maps, Enhanced Through GIS : The Facilities

The GIS was initially developed as an improvement over mapping, with additional capabilities of overlaying, measurement, digitizing and scanning, later evolutes into a System for creating, storing

analyzing and managing spatial data with related attributes. Not only this these days, the GIS works as a tool, that allows users to create interactive queries, analyze the spatial information and undertakes suitable editing of such data. In simpler words, GIS makes use of georefencing techniques to correlate the geographical information to the earth, with the application of geometric techniques to represent the real world phenomena in space and time [Raper.2002]. There is a growing trend of free open sourcing GIS packages, compatible with a range of Operating Systems with ability to customize to perform many spatial tasks. The Arcview (from ESRI), AutoCAD Map (from AutoDesk), Imagine (from Erdas), Geo Media (from Intergraph), MapInfo (from MapInfo) and , Smallworld(from GE Smallworld), etc. are the instances, [www.gis.com].

The requisite map metadata for the HIS, in the context of its various dimensions can conveniently be gathered through GIS. Further the information may be analyzed or synthesized though its automated facilities customized as per Indexers' requirements. Not only this information can be forwarded in various icons for the further processing.

5. Procedures for Hybrid Indexing for Maps Enhanced Through GIS : The Steps

With the map metadata in hand, compatible with computer application, the process for Index generation can be undertaken though the steps as :-

5.1 Map Contents Analysis and Synthesis :

Initial stage of preparation for Index ask for analysis and synthesis of the Map contents i.e. prevailing features. The step can be facilitated through the GIS.

5.2 Map Contents Ascertaining the Predominant Features :

The facts supplied through Step - I would enable the indexer to ascertain the prominent features, pertaining to the various maps dimensions, through the significant role played by the GIS.

5.3 Map Contents : Symbolic Conversion of Prevailing Features :

Once the ruling features being fixed, for the process of CNBI, it is requisite that the same be converted into parallel- standardized symbols i.e. Icons. Here the usage of various colors, shapes and texture would prove helpful.

5.4 Content- Concept Transition :Geographic Vocabulary for Index Generation

At this juncture geographic vocabulary in the form of genuine geographic thesaurus is required, for the purpose of interpreting the respective icons into the Concepts. The correlation would make the further process of Indexing feasible.

5.5 Context-Concept Transition : Matching of Symbols with Geographic terms

With small programs, the Icons can be correlated with the geographic terms representing particular map contents. The instructions thus inculcated would work as a link between the map features i.e. content and the respective geographic vocabulary i.e. concepts therein.

5.6   Map Concepts : Entry Generation :

The step relates to the transformation of the map contents into the map concepts, which can further follow the principles of any CCBI. However, the compatibility with the computer applications has to be taken care of.

5.7   Hybrid Map Index : Tool Customization

Index customization is the next essential step to facilitate the convenient use of the Index. For the purpose, proper keys, instructions and preferably menu driven facilities be offered to the map users.

This way, the maps, which as a source of information is unsuitable either for the Concept or the Content Based Indexing, can be indexed through Hybrid System of Indexing facilitated through GIS.

6.   Image Indexing : The Experimental Scenario

Since the non-traditional documents like images, pictures, paintings, diagrams, music scores and maps etc cannot be indexed through CCBI ,the experts have been working for developing suitable Indexing techniques for the purpose. Greisdorf and Connor [2002] while studying the Content Based elements came to the conclusion, that users when consulting such non-traditional documents, tend to look for descriptive context/s, accompanying images for the cognitive purposes, and their respective interpretation is based on the same. Therefore the image, in the absence of the descriptive notes may lead to different interpretations by the different users. Besides, the differentiating meaning is going to be highly subjective, as compared to that derived from the standardized texts. [Markey, 1984]. Bovey [1993] while taking on images especially focuses on the cartoon images and discusses at length, the graphical retrieval system, called 'Prism'. The System operates for the retrieval purposes, on online catalogue of original cartoon drawings at the University of Kent. Besides the Prism has a largely directly manipulated graphical-user interface, which stores and displays digitized images along with conventional textual catalogue records. Wang [2001] for the purposes of CNBI has emphasized on Region Based Indexing, where an image in a database, is represented by a set of regions, characterized by color, texture, shape and location. The System thus devised classifies Images into semantic categories for the retrieval purposes. Nubila et.al(1994) devised an Indexing System for the radiologists, whereby the reports consisting of synthetic description through visual analysis was made explicit through graph data structures. In simpler terms, the graph was considered to be the result of Indirect Indexing of the radiograms and was explored to retrieve the reported radiograms by their contents.

In the stream of CCBI, Enser [2000] has worked on a Concept Based System for a collection of pictures. For the purpose, query is verbalized by the client and is recorded as a metadata text-matching operation. For the process, the image digitization plays the prominent role for the retrieval purposes. Hauck et.al. (2001) has experimented on Concept Based searching by the Geo-Scientists. The experiment conducted on a test bed of 22,636 Geoscience Abstracts was provided through NSF/DARPA/NASA. The objective of the experiment was to fix the role of Concept Based tool/s for improving the precision and recall pertaining to Geoscience Information Retrieval over using only the searcher's keywords. The characteristics of the overall collection, as well as those of Users' group found to be detrimental, while regarding the performance of their applications.

Thus neither the concept nor the content can build the proper bases for an ideal Indexing System, and should rather complement each other, in order to negate their respective faults and to combine their positive aspects for the Image Retrieval System.

7. Conclusion

In context of electronic era, heavy use of Multi-media is in ever- increasing mode. In such a scenario, it is difficult for Library & Information Professionals to ignore the related sources of information. And there is urgent need that new system/s be devised, for the adequate storage and retrieval of these upcoming non-conventional documents. Though keeping pace with these greatly transforming information formats/ versions, is not going to be a convenient task, but the job has to be accomplished in any case. Since, working on existing Information System/s, for the respective enhancement remains no longer a luxury but has become a necessity for the very survival of Library & Information Professionals in the electronic age.

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