Efficient Approach for Webpage Segmentation

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Abstract

With the enormous growing amount of information available on the Internet, an effective technique for users to apprehend the useful information from the unnecessary information is urgently required. Cleaning Web pages before mining becomes critical for improving performance of information retrieval and information extraction. So, we propose to remove various noisy data patterns in Web pages instead of extracting relevant content from Web pages to get main content information. Cleaning web pages before mining includes Web page segmentation.Content mining is the scanning and mining of text, pictures and graphs of a Web page to determine the relevance of the content to the search query. Cleaning web pages before mining includes Web page segmentation. In this, the webpage segmentation is done by using VIPS algorithm (Vision Based Page Segmentation).We see that Page segmentation is effective when applying VIPS algorithm rather than DOM (Document Object Model). We have implemented our method on several commercial Web sites and News Websites to evaluate the performance and improvement of our approach. Experimental results show the effectiveness of the approach. In this paper we show that VIPS is more efficient than DOM.

Keywords

DOM,VIPS,Page Segmentation

1. Introduction

Web page contains an enormous amount of information, which is having blocks; sections etc. These blocks may contain navigations, main content, ads etc. Being able to identify a block within a web page that represents the primary topic of that page may help a search engine decide which words are the most important ones on the page when it tries to associate the page with keywords that someone might search with to find that page. These blocks are very useful at the time of indexing the Webpages .when a person wants to search for a particular item, the keyword, by search engines are matched with the blocks which may specify the main content information .by dividing the page into blocks search engine can easily relate to, what is the topic that is most relevant. By dividing the page the weight or priority for a particular web page link will have more value, it is also helpful for eliminating noisy data. Pages that appear in search results where the query terms searched for are related to the primary content of those pages are likely to provide a much better experience for a searcher than pages appearing in those search results where noise on the page is related to the query searched for by someone. Today the Web has become the largest information source for people. Most information retrieval systems on the Web regard web pages as the smallest and undividable units, but a web page as a whole may not be appropriate to represent a single topic. A web page usually contains various contents such as navigation, decoration, interaction and contact information, which are not related to the topic of the web-page. Furthermore, a web page often contains multiple topics that are not necessarily relevant to one another. Therefore, detecting the semantic content structure of a web page could potentially improve the performance of web information retrieval.

2. DOM (Document Object Model)

The Document Object Model (DOM) is an application programming interface (*API*) for valid *HTML* and well-formed *XML* documents. It defines the logical structure of documents and the way a document is accessed and manipulated. In the DOM specification, the term "document" is used in the broad sense - increasingly, XML is being used as a way of representing many different kinds of information that may be stored in diverse systems, and much of this would traditionally be seen as data rather than as documents. Nevertheless, XML presents this data as documents, and the DOM may be used to manage this data.

With the Document Object Model, programmers can build documents, navigate their structure, and add, modify, or delete elements and content. Anything found in an HTML or XML document can be accessed, changed, deleted, or added using the Document Object Model, with a few exceptions - in particular, the DOM *interfaces* for the XML internal and external subsets have not yet been specified.

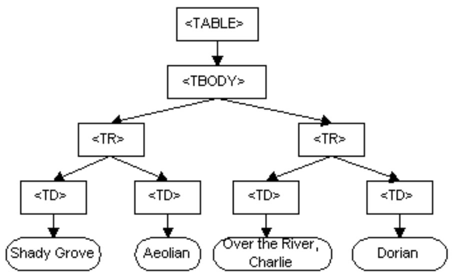
As a W3C specification, one important objective for the Document Object Model is to provide a standard programming interface that can be used in a wide variety of environments and *applications*. The DOM is designed to be used with any programming language. In order to provide a precise, language-independent specification of the DOM interfaces, we have chosen to define the specifications in Object Management Group (OMG) IDL [OMGIDL], as defined in the CORBA 2.3.1 specification [CORBA]. In addition to the OMG IDL specification, we provide bindings for Java [Java] and ECMAScript [ECMAScript] (an industrystandard scripting language based on JavaScript [JavaScript] and Script [JScript]).

HTML DOM tree tries to extract the structural information from the web pages. DOM provides each web page with a fine-grained structure, which illustrates not only the content but also the presentation of the page. In general, similar to discourse passages, the blocks produced by DOM-based methods tend to partition pages based on their pre-defined syntactic structure, i.e., the HTML tags. There are some approaches that take into account the problem of page segmentation, but there is no consistent way to do it and, to the best of our knowledge, few works are done on applying DOM based page segmentation methods on web information retrieval. Some simple experiments are performed, where sub-trees tagged with <TITLE>, <P>, <H1>~<H3> and <META> are treated as blocks, but the results are not encouraging. The reasons may lie in the following three aspects.

First, DOM is still a linear structure, so visually adjacent blocks may be far from each other in the structure and departed wrongly. Secondly, tags such as <TABLE> and <P> are used not only for content presentation but also for layout structuring. It is therefore difficult to obtain the appropriate segmentation granularity. Thirdly, in many cases DOM prefers more on presentation to content and therefore not accurate enough to discriminate different semantic blocks in a web page.

The DOM is a programming *API* for documents. It is based on an object structure that closely resembles the structure of the documents it *models*. For instance, consider this table, taken from an HTML document:

```
<TABLE>
<TBODY>
<TR>
<TD> Shady Grove </TD>
<TD> Aeolian </TD>
</TR>
<TR>
<TD> Over the River, Charlie </TD>
<TD>Dorian </TD>
</TR>
</TBODY>
</TABLE>
```



graphical representation of the DOM of the example table

Figure 1: Graphical Representation of DOM

In the DOM, documents have a logical structure which is very much like a tree; to be more precise, which is like a "forest" or "grove", which can contain more than one tree. Each document contains zero or one doctype nodes, one root element node, and zero or more comments or processing instructions; the root element serves as the root of the element tree for the document. However, the DOM does not specify that documents must be *implemented* as a tree or a grove, nor does it specify how the relationships among objects be implemented.

The DOM is a logical model that may be implemented in any convenient manner. In this specification, we use the term *structure model* to describe the tree-like representation of a document. We also use the term "tree" when referring to the arrangement of those information items which can be reached by using "tree-walking" methods; (this does not include attributes). One important property of DOM structure models is *structural isomorphism*: if any two Document Object Model implementations are used to create a representation of the same document, they will create the same structure model, in accordance with the XML Information Set [Infoset].

The name "Document Object Model" was chosen because it is an "*object model*" in the traditional object oriented design sense: documents are modeled using objects, and the model encompasses not only the structure of a document, but also the behavior of a document and the objects of which it is composed. In other words, the nodes in the above diagram do not represent a data structure; they represent objects, which have functions and identity. As an object model, the DOM identifies:

- the interfaces and objects used to represent and manipulate a document
- the semantics of these interfaces and objects - including both behavior and attributes
- the relationships and collaborations among these interfaces and objects

The structure of SGML documents has traditionally been represented by an abstract *data model*, not by an object model. In an abstract *data model*, the model is centered around the data. In object oriented programming languages, the data itself is encapsulated in objects that hide the data, protecting it from direct external manipulation. The functions associated with these objects determine how the objects may be manipulated, and they are part of the object model..

3. Vision-based Content Structure for Web Pages

In this paper, we propose the vision-based content structure, where every node, called a *block*, is a basic object or a set of basic objects. It is important to note that, the nodes in the vision-based content structure do not necessarily correspond to the nodes in the DOM tree. Similar to the description of document representation in [Tang et al. 1999], the basic model of *vision-based content structure* for web pages is described as follows. A web page Ω is represented as a tripleΩ = (*O*, Φ, δ). *O* = {Ω1, Ω2, ΩN*}* *is* a finite set of blocks. All these blocks are not overlapped. Each block can be recursively viewed as a sub-webpage associated with sub structure induced from the whole page structure. Φ = {ϕ 1, ϕ

2, ф *T}* is a finite set of separators, including horizontal separators and vertical separators. Every separator has a weight indicating its visibility, and all the separators in the same Φ have the same weight. *i*s the relationship of every two blocks in O and can be expressed as:δ = *O*×*O*→Φ∪{*NULL*}.For example, suppose Ωi and Ωj are two objects in O, (,) *i j* δ Ω Ω ≠ *NULL* indicates that Ωi and Ωj are exactly separated by the separator (,) *i j* δ Ω Ω or we can say the two objects are adjacent to each other, otherwise there are other objects between the two blocks Ωi and Ωj. Since each Ωi is a sub-web-page of the original page, it has similar content structure as Ω.Recursively, we have *t* (*t* , *t* , *t*) *s s s s* Ω = *O* Φ δ , *t* { 1 , 2 ,..., *Nst* } *s st st st O* = Ω Ω Ω , *t* { 1 , 2 ,..., *Tst* } *s st st st* Φ = ф ф ф and *t t t t* { }*s s s s* δ = *O* ×*O* →Φ ∪*NULL* where *t s* Ω is the *t*th object in the sub-web-page level *s*, *Nst* and *Tst* are the number of objects in *t s O* and number of separators in *t s* Φ

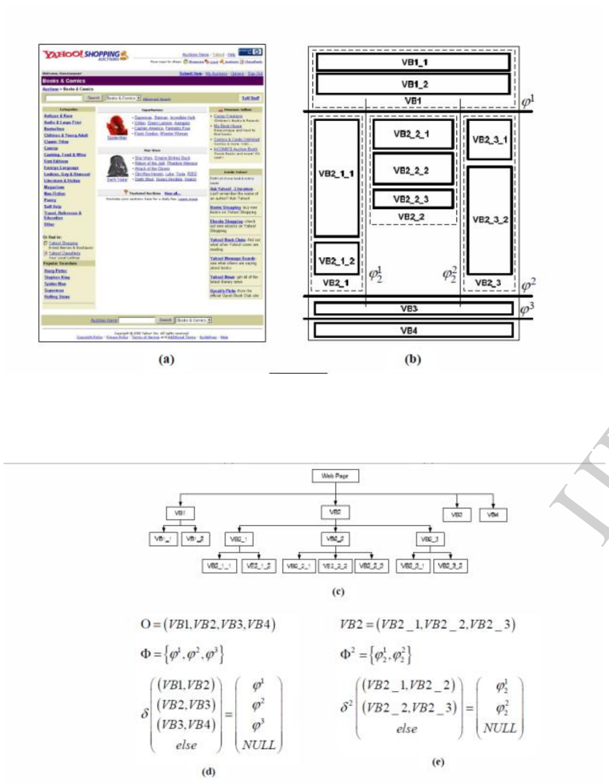


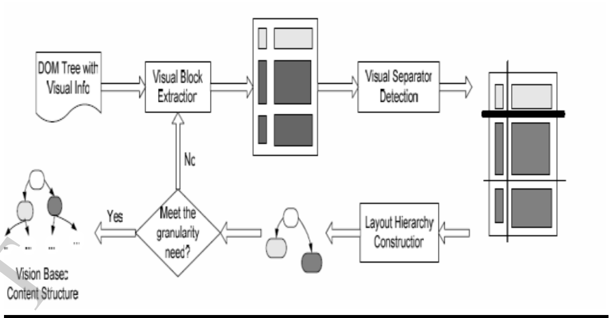
Figure 2: Example of vision-based content structure for a web page of Yahoo!

Figure 2 shows an example of vision-based content structure for a web page of Yahoo!Illustrates the layout structure and the vision-based content structure of the page. In the first level, the original web page has four objects or visual blocks VB1~VB4 and three separators ф 1 ~ф 3, as specified in Figure 2(d). Then we can further construct sub content structure for each sub webpage. For example, VB2 has three offspring objects and two separators. It can be further analyzed as shown in Figure 2(e).For each visual block, the *Degree of Coherence* (DoC) is defined to measure how coherent it is. DoC has the following properties:

- The greater the DoC value, the more consistent the content within the block;
- In the hierarchy tree, the DoC of the child is not smaller than that of its parent.

In our algorithm, DoC values are integers ranging from 1 to 10, although alternatively
different ranges (e.g., real numbers, etc.) could be used. We can pre-define the *Permitted Degree of Coherence* (PDoC) to achieve different granularities of content structure for different applications. The smaller the PDoC is, the coarser the content structure would be. For example in Figure 2(a), the visual block VB2_1 may not be further partitioned with an appropriate PDoC. Different application can use VIPS to segment web page to a different granularity with proper PDoC. The vision-based content structure is more likely to provide a semantic partitioning of the page. Every node of the structure is likely to convey certain semantics. For instance, in Figure 2(a) we can see that VB2_1_1 denotes the category links of Yahoo! Shopping auctions, and that VB2_2_1 and VB2_2_2 show details of the two different comics.

The VIPS Algorithm


DOM Tree with Visual Info
Visual Block Extraction
Visual Separator Detection
Nc
Yes
Meet the granularity need?
Layout Hierarchy Construction
Vision Based Content Structure

5 Experiments

In this section, we will first show two example pages, comparing our VIPS result and the DOM tree structure. Then we provide some performance evaluation of our proposed VIPS algorithm based on a large collection of web pages from Yahoo. We also conduct experiments to evaluate how the algorithm can be used to enhance Web information retrieval.

5.1 Simple examples of web page segmentation

In this sub-section, the segmentation results of two web page are presented to give people an
intuition how our VIPS algorithm works. In the meantime, we show the DOM tree of these pages. We can clearly find that we cannot get the right structure of the blocks only based on naïve DOM tree. Moreover, it is hard for us to decide which node conveys semantic meanings and where we should stop in different applications. Figure 3(a) shows our VIPS result on a sample page1. The left part shows the page with different regions (different visual blocks in VIPS algorithms) marked with rectangles. The block marked with red rectangle is the block VB1-2-2-1. The upper right part shows the vision-based content structure of this page, while the lower one shows some statistics of selected visual block. From the right VIPS tree, we can know the hierarchical structure of different blocks. In different applications, we can control the partition granularity by setting PDoC, as shown in the northeast corner. The DoC value of each block is shown behind the node name (in parenthesis) in the right VIPS tree. Although from page

layout we see that VB1-2-1, VB1-2-2-1 and VB1-2-2-1 are parallel, in our heuristic rules the separator between VB1-2-1 and VB1-2-2-1 will get higher weight than the separator between VB1-2-2-1 and VB1-2-2-1 because of the different background colors. So VB1-2-2-1 and VB1-2-2-2 will be merged to VB1-2-2, paralleled to VB1-2-1.

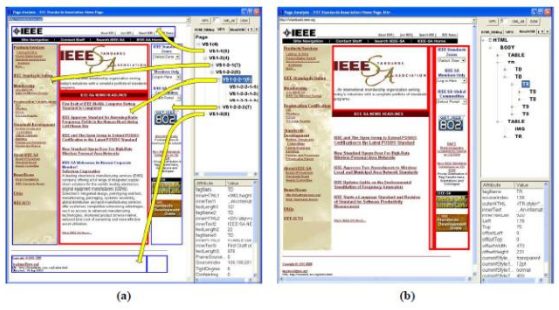


Figure 3: Segmentation results of an IEEE page

For comparison, we show the DOM tree and its corresponding blocks in Figure 3(b). Wecan see that the area marked with red line is a <TR> node (with three <TD> children). From visual perspective, these <TD> nodes should not be grouped together, but we cannot get thisinformation from DOM tree structure, while in VIPS this problem can be solved with the spatial and visual information of these blocks. We got the right content structure using our VIPS algorithm. Take another example web page1. We show the DOM tree structure and VIPS segmentation result in Figure 4.

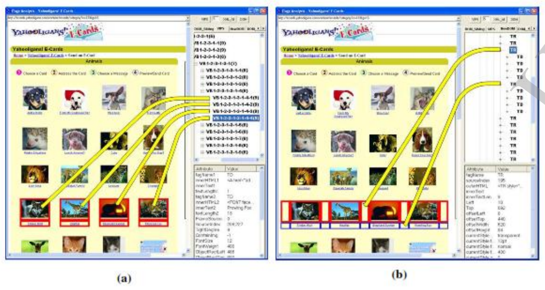


Figure 4: Segmentation results (a) VIPS (b) DOM

In DOM tree structure, the images and the texts are belonging to different <TR> nodes. It is hard to decide the exact description text of the image. VIPS result clearly reveals the semantic relationship of the images and their surrounding texts. We can use these surrounding texts to represent the images and used this text representation in a web image search system.

From these examples, we can see that our VIPS algorithm can successfully identify therelationships among different blocks in the web page, while DOM structure fails. Moreover,
VIPS algorithm assigns a DoC value to each node in vision-based content structure, which iscritical in determining where to stop in different applications.

5.2 Performance of VIPS algorithm

To evaluate the performance of VIPS algorithm, we select 600 web pages from popular siteslisted in 14 main categories of Yahoo! directory (http://www.yahoo.com). The VIPS algorithm is run on all the pages and the results are assessed by several individuals. Five volunteers are asked to judge the results. Table 1 shows the result

Human judgment	user1	user2	user3	user4	user5	All
Perfect	299	307	374	310	377	1667
Satisfactory	231	266	193	237	197	1124
Fair	64	23	29	48	20	184
Bad	6	4	4	5	6	25

Table 1: Evaluation of VIPS Algorithm

As can be seen, 1667+1124=2791 (93%) pages have their semantic content structurescorrectly detected. For those “fair” pages, the hierarchies are incorrectly constructed because
They contain insufficient visual cues to separate blocks while people get the structure byunderstanding the semantic meaning of the blocks. For the “bad” cases, one major reason is that the browser (i.e. Internet Explorer in our experiments) provides wrong position information so that our algorithm cannot get the correct content structure. Another reason is that, for several pages the images (e.g., a very thin image representing a line) are used to divide different content blocks. Our algorithm currently cannot handle this situation.

5.3 Experiments on web information retrieval

Query expansion is an efficient way to improve the performance of information retrieval [Buckley et al. 1992] [Efthimiadis 1996]. The quality of expansion terms is heavily affected by the top-ranked documents. Noises and multi-topics are the two major negative factors for expansion term selection in the web context. Since our VIPS algorithm can group semantically related content into a block, the term correlations within a segment will be much higher than those in other parts of a web page. With improved term correlations, high-quality expansion terms can be extracted from segments and used to improve information retrieval performance. We choose Okapi [Robertson 1997] as the retrieval system and WT10g [Bailey 2001] in TREC-9 and TREC 2001 in Web Tracks as the data set. WT10g contains 1.69 million pages and amounts to about 10G. The 50 queries from TREC 2001 Web Track are used as the query set and only the TOPIC field for retrieval, and use Okapi’s BM2500 [Robertson et al. 1999] as the weight function and set $k1$ = 1.2, $k3$ = 1000, b = 0.75, and $avdl$ = 61200. The baseline is 16.55% in our experiments.

An initial list of ranked web pages is obtained by using any traditional information retrievalmethods. Then we apply different page segmentation algorithms (including our VIPS algorithm with PDoC (6) and a naïve DOM-based approach) to the top 80 pages and get the set of candidate segments. The most relevant (e.g. top 20) segments from this candidate set are used to select expansion terms. These selected terms are used to construct a new expanded query to retrieve the final results.

We compared our method with the traditional pseudo-relevance feedback algorithm usingwhole document and a naïve segmentation method based on DOM tree, which are brieflydescribed below:

- Our Vision-based approach (denoted as VIPS): The PDoC is set to 6. To reduce the effect of tiny blocks, blocks less than 10 words are removed. The top 80 pages returned by the initial retrieval phase are segmented to form the candidate segment set.

- Simple DOM-based approach (denoted as DOMPS): We iterate the DOM tree for some structural tags such as TITLE, P, TABLE, UL and H1~H6. If there are no more structural tags within the current structural tag, a block is constructed and identified by this tag. Free text between two tags is also treated as a special block. Similar to VIPS, tiny blocks less than 10 words are also removed, and the candidate segments are chosen from the top 80 pages returned by the initial retrieval phase.

- Traditional full document approach (denoted as FULLDOC): The traditional pseudo relevance feedback based on the whole web page is implemented for a comparison purpose.
  The experimental result is shown in Table 2

Number of Segments	Baseline (%)	FULLDOC (%)	DOMPS (%)	VIPS (%)
3		17.56 (+6.10)	17.94 (+8.40)	18.01 (+8.82)
5		17.46 (+5.50)	18.15 (+9.67)	19.39 (+17.16)
10		**19.10 (+15.41)**	18.05 (+9.06)	19.92 (+20.36)
20	16.55	17.89 (+8.10)	19.24 (+16.25)	**20.98 (+26.77)**
30		17.40 (+5.14)	19.32 (+16.74)	19.68 (+18.91)
40		15.50 (-6.34)	19.57 (+18.25)	17.24 (+4.17)
50		13.82 (-16.50)	**19.67 (+18.85)**	16.63 (+0.48)
60		14.40 (-12.99)	18.58 (+12.27)	16.37 (-1.09)

Table 2: Performance comparison of query expansion using different page segmentationmethods

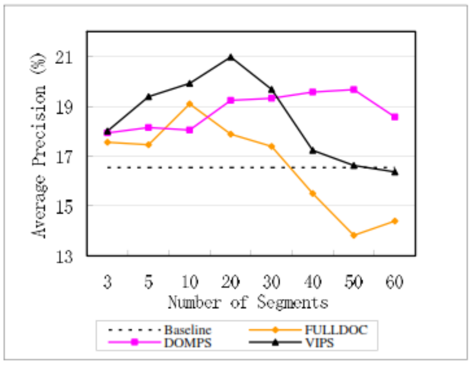


Figure 5: Performance comparison of pseudo-relevance feedback based on three different ways of selecting

be hich , the 10 documents are used to expand the query. DOMPS obtains 19.67% when the top 50 blocks are used, a little better than FULLDOC. VIPS gets the best result 20.98% when the top 20 blocks are used and achieves 26.77% improvement. Document based query expansion FULLDOC uses all the terms within the top documents for expansion. Since the baseline is very low, many of top ranked documents are actually irrelevant and there are many terms coming from irrelevant topics. These cause the retrieval performance relatively low although better than the baseline. For the same reason, the average precision drops quickly DOM based approach DOMPS does not obtain a significant improvement compared with FULLDOC, partly because the segmentation is too detailed.

The segments are usually too short to cover complete information about a single semantic. This is a major limitation of segmentation based on naïve DOM tree which we addressed before. In many cases, good expansion terms are within the previous or proceeding blocks, but are missed because those blocks are not ranked high enough to be selected in pseudo-relevance feedback. Compared with DOMPS, our VIPS algorithm considers more visual information and is more likely to obtain a semantic partition of a web page. Therefore, better expansion terms can be extracted and better performance can be achieved. About 27% performance improvement on the Web Track dataset was achieved. The experiments clearly show that vision-based web page content structure is very helpful to detect and filter out noisy and irrelevant information. Thus better expansion terms can be selected to improve retrieval performance.

6 .Conclusions

In this paper a new approach for extracting web content structure based on visual representation was proposed. The produced web content structure is very helpful for applications such as web adaptation, information retrieval and information extraction. By identifying the logic relationship of web content based on visual layout information. In this paper, we proposed the vision-based content structure, where every node, called a *block*, is a basic object or a set of basic objects. It is important to note that, the nodes in the vision-based content structure do not necessarily correspond to the nodes in the DOM tree.

7. References:

- Adelberg, B., NoDoSE: A tool for semi-automatically extracting structured and semi-structured data from text documents, In Proceedings of ACM SIGMOD Conference on Management of Data, 1998, pp. 283-294.

- Ashish, N. and Knoblock, C. A., Semi-Automatic Wrapper Generation for Internet Information Sources, In Proceedings of the Conference on Cooperative Information Systems, 1997, pp. 160-169.

- Ashish, N. and Knob lock, C. A., Wrapper Generation for Semi-structured Internet Sources,
- SIGMOD Record, Vol. 26, No. 4, 1997, pp. 8-15.

- Bailey, P., Craswell, N., and Hawking, D., Engineering a multi-purpose test collection for Web retrieval experiments, Information Processing and Management, 2001.

- Bar-Yossef, Z. and Rajagopalan, S., Template Detection via Data Mining and its Applications, InProceedings of the 11th International World Wide Web Conference (WWW2002), 2002.

- Bernard, M. L... Criteria for optimal web design (designing for usability). 2002.

- Bharat, K. and Henzinger, M. R., Improved algorithms for topic distillation in a hyperlinked environment, In Proceedings of the 21st ACM International Conference on Research and Development in Information Retrieval (SIGIR98), 1998, pp. 104-111.
- Buckley, C., Salton, G., and Allan, J., Automatic Retrieval with Locality Information Using Smart, In the First Text Retrieval Conference (TREC-1), National Institute of Standards and Technology, Gaithersburg, MD, 1992, pp. 59-72.

- Butler, D., Liu, L., and Pu, C., A Fully Automated Object Extraction System for the World Wide Web, In International Conference on Distributed Computing Systems, 2001.
- Buyukkokten, O., Garcia-Molina, H., and Paepche, A., Accordion Summarization for End-GameBrowsing on PDAs and Cellular Phones, In Proceedings of the Conference on Human Factors in Computing Systems, CHI'01, 2001.

- Chakrabarti, S., Integrating the Document Object Model with hyperlinks for enhanced topic Distillation and information extraction, in the 10th International World Wide Web Conference, 2001.

- Chakrabarti, S., Joshi, M., and Tawde, V., Enhanced topic distillation using text, mark-up tags, and hyperlinks, In Proceedings of the 24th annual international ACM SIGIR conference on Research and development in information retrieval , ACM Press, 2001, pp. 208-216.

- Chakrabarti, S., Punera, K., and Subramanyam, M., Accelerated focused crawling through online relevance feedback, In Proceedings of the eleventh international conference on World Wide Web (WWW2002), 2002, pp. 148-159.

- Chen, J., Zhou, B., Shi, J., Zhang, H.-J., and Wu, Q., Function-Based Object Model Towards Website Adaptation, In Proceedings of the 10th International World Wide Web Conference, 2001.

- Diao, Y., Lu, H., Chen, S., and Tian, Z., Toward Learning Based Web Query Processing, In Proceedings of International Conference on Very Large Databases, 2000, pp. 317-328.

- Efthimiadis, N. E., Query Expansion, In Annual Review of Information Systems and Technology, Vol. 31, 1996, pp. 121-187.

- Embley, D. W., Jiang, Y., and Ng, Y.-K., Record-boundary discovery in Web documents, In Proceedings of the 1999 ACM SIGMOD international conference on Management of data, Philadelphia PA, 1999, pp. 467-478.

- Hammer J., Garcia-Molina, H., Cho, J., Aranha, R., and Crespo, A., Extracting Semi-structured Information from the Web, In Proceedings of the Workshop on Management for Semi-structured Data, 1997, pp. 18-25.

- Kaasinen, E., Aaltonen, M., Kolari, J., Melakoski, S., and Laakko, T., Two Approaches to bringing Internet Services to WAP Devices, In Proceedings of 9th International World-Wide Web Conference, 2000, pp. 231-246.

- Kleinberg, J., Authoritative sources in a hyperlinked environment, In Proceedings of the 9th ACM-SIAM Symposium on Discrete Algorithms, Baltimore, MD, USA, 1998, pp. 668-677.

- Lin, S.-H. And Ho, J.-M., Discovering Informative Content Blocks from Web Documents, In proceedings of ACM SIGKDD'02, 2002.

- Page, L., Brin, S., Motwani, R. and Winograd, T. The Page Rank citation ranking: Bringing order to the web, Technical report, Stanford University, Stanford, CA, 1998.

- Rahman, A., Alam, H., and Hartono, R., Content Extraction from HTML Documents, In proceedings of the First International Workshop on Web Document Analysis (WDA2001), 2001.

- Robertson, S. E., Overview of the okapi projects, Journal of Documentation, Vol. 53, No. 1, 1997, pp. 3-7.

- Robertson, S. E. and Walker, S., Okapi/Keenbow at TREC-8, In the Eighth Text Retrieval Conference (TREC 8), 1999, pp. 151-162.

- Tang, Y. Y., Cheriet, M., Liu, J., Said, J. N., and Suen, C. Y., Document Analysis and

Recognition by Computers, Handbook of Pattern Recognition and Computer Vision, edited by C.

- H. Chen, L. F. Pau, and P. S. P. Wang World Scientific Publishing Company, 1999.

- Wong, W. and Fu, A. W., Finding Structure and Characteristics of Web Documents for Classification, In ACM SIGMOD Workshop on Research Issues in Data Mining and Knowledge Discovery (DMKD), Dallas, TX., USA, 2000.