Effective Utilization Technique for Simplified Navigation through Website Structure Improvement

Devakinanda K Kiriti K [#1]
[#1] M.Tech Scholar
Department of CSE,
Kaushik College of Engineering and Technology,
Visakhapatnam, AP, India.

Mr. S.Venkatarao *[2]
[*2] Assistant Professor
Department of CSE,
Kaushik College of Engineering and Technology,
Visakhapatnam, AP, India.

Abstract

Now a day's designing a web site with all well-structured designs to facilitate effective user navigation has become a very complex problem. Many designers have complained about the right structure designing, and different users have complained about poor website structure.Our research work has shown various reasons for this current problem, a primary reason for this current challenge is the understanding of web developers of how a website should be structured can be considerably different from that of the normal users. While there was various methods which have been proposed till to date to relink web pages to improve navigability using user navigation data, the completely reorganized new structure can be highly unpredictable, and the cost of disorienting users after the changes remains unanalyzed. In this paper, we address mainly how to improve an existing website without introducing substantial new changes. Specifically, we propose a new mathematical programming model which is implemented in java to improve the user navigation on a website while minimizing alterations to its current structure. Results from extensive tests conducted on a publicly available real data set indicate that our model not only significantly improves the user navigation with very few changes, but also can be effectively solved.

Keywords

User Navigation, Mathematical Programming, Website Design, Web Mining.

1. Introduction

Now a day's, the usage of web has emerged and became the most important source for information sharing and communication between one another. Websites are growing rapidly to serve different visitors or web-users for different purposes with its own structure. Due to such a rapid growth of websites, Web accessing and effective structured design has become a challenge. It has been clearly noticed that websites that have poor information and structure makes the visitors get lost and feel disoriented. To respond to such challenges, we propose an effective web user navigation technique through website structure improvement. Since there was very fast -growing number of internet users, there was a huge business opportunities to firms. According to Grau [2], [3] the US retail e-commerce sales (excluding travel) totaled $137.7 billion in 2007 and will reach $210.4 billion by 2013. For this reason, in order to satisfy the increasing demands from online customers, firms are heavily investing in the development and maintenance of their websites.

Even though there is a huge cost needed in any website design, it is still revealed, however, that finding the useful information from that designed website is not so easy [4] and also it reveals that designing effective websites is not a trivial task [5], [6]. One of the authors like Galletta et al. [7] clearly tells that online sales lag far behind those of brick and mortar stores and at least part of the gap might be explained by a major difficulty

user's encounter when browsing online stores. Another author like Palmer [8] also highlighted that in maximum number of high profile site failures, more number of cases are caused due to poor website design. Another author like McKinney et al. [9] also found that users who wish to use the high quality website leaves the web sites in times if the locating the targets are not able to identify easily by that surfing user.

One of the main causes of poor website design is that the web developers' understanding of how a website should be structured can be considerably different from those of the normal users [10], [11]. Such differences may sometimes result in cases where users cannot easily identify the required information from that website. This type of problem is very difficult to avoid during any website creation, because web developers initially may not have a clear idea or user interests and can only organize pages based on their own judgments. However, for any website the measure of website effectiveness will be decided based on satisfaction of the web users rather than that of the web developers. Thus, we finally conclude that webpage's should be organized in a way that generally matches the user's model of how pages should be organized rather than developer's choice [12].

In this paper, we mainly concentrated on transformation approaches. The literature survey what we have made in this paper on transformations approaches mainly focuses on developing methods to completely reorganize the link structure of a website. Initially, a complete reorganization could periodically change the location of familiar items, the creation of new website may disclose users [13]. Second, the reorganized website structure is highly unpredictable, and the cost of disorienting users after the changes remains unanalyzed. This is because a website's structure is typically designed by experts and bears business or organizational logic, but this logic may no longer exist in the new structure when the website is completely reorganized.

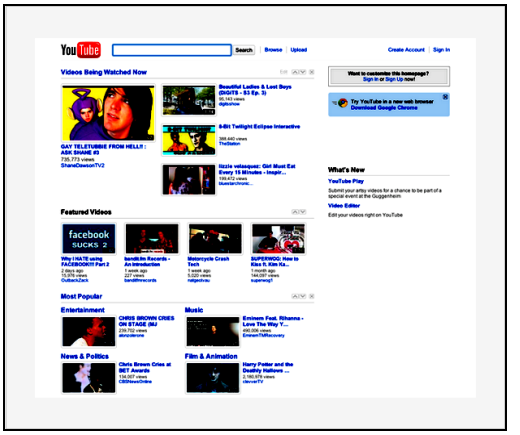
By identifying the drawbacks that were caused by website reorganization approaches, we address mainly the following question of how to improve the structure of any existing website rather than rearrange it periodically. For this reason , we develop a new mathematical programming (MP) model that facilitates user navigation on a website with some small changes to its current structure without effecting with more changes. Our proposed model is particularly useful for large number of information based websites whose contents are almost static and relatively stable over time. Examples of some of the information based websites are colleges, national universities, tourist attractions, hospitals, and sports organizations. Our proposed MP model, however, may not be suitable for some of the websites that purely use dynamic pages or have volatile contents. This is not possible because a steady state might never be reached in user access patterns in such websites, so it may not be possible to use the weblog data to improve the site structure **[**16].

Example for a Well Structured Websites

We will look at some of the best websites which are simple and well designed and usable by a lot of users.

1. YouTube.com

YouTube is the one of biggest video sharing web site in the world, and it is ranking the number 3 in overall web sites in the world(according to alexa at least). YouTube is to video as Google is to search.



Why It's Good

I would be the first to say, YouTube web site doesn't have the most attractive design out there, but it is so functional, and the design works so well for what it does that it isn't an issue. More or less everyone I know can and does use YouTube on a regular basis. My own grandmother, without any help or advice, has hunted down a huge range of kids TV shows for my nephew to watch, played them full screen, high quality, and bookmarked them for future viewing. This goes to show just how usable and functional it is.

2. Dropbox.com

Dropbox is a backup system that allows us to sync our files online, and across many different computers automatically. We can also share files through public links, access files online, on our computer(s) and apps on several different platforms (iOS, Android etc.) – there are really a number of great features.

Why It's Good

Dropbox is a most famous and fantastic site for a number of different reasons, but the reason it really stands out is that it just works. Whether we are transferring files in the same room or from country to country, whether we are using mobile devices, Macs, PCs, whatever our usage scenario, it just works. The fact in, it slips into our workflow so smoothly, we don't even notice it's there, and there are so many wonderful features that we don't really think about until we need them, but they are always there. It's like they read my mind, and put in all the great features before I needed them, and made it fantastically easy to use too.

2. Related Work

Web personalization is a new process of "tailoring" web pages to the needs of specific users using the information of the users' navigational behavior and profile data [17]. Some of the authors like Perkowitz and Etzioni [11] describe a new approach that automatically synthesizes index pages which contain links to pages pertaining to particular topics based on the co-occurrence frequency of pages in user traversals, to facilitate user navigation. The methods which are proposed by Mobasher et al. [18], [19], [20] and Yan et al. [21] create a number of clusters of user's profiles from weblogs and then dynamically generate links for users who are classified into different categories based on their access patterns.

Web sites are mainly designed for facilitatating knowledge acquisition, often in the interest of supporting decision making by the user. Based on following factors which are influenced by Web site usability, hypotheses is developed about usability of alternative navigation structures. These hypotheses are initially tested via several simulation experiments that are used for measuring user performance in knowledge acquisition tasks and user perceptions of usability.

There are several remarkable differences between both the approaches like web transformation and personalization approaches.

Initially, the transformation approaches mainly create or modify the structure of any new website used for all users; on the other side personalization approaches dynamically reconstitute pages for individual users. Hence, by these differences we conclude that, there is no predefined/built-in web structure for personalization approaches. Second, in order to understand clearly the preference of individual users, personalization technique mainly needs to collects the users area of interests also known as user profiles.

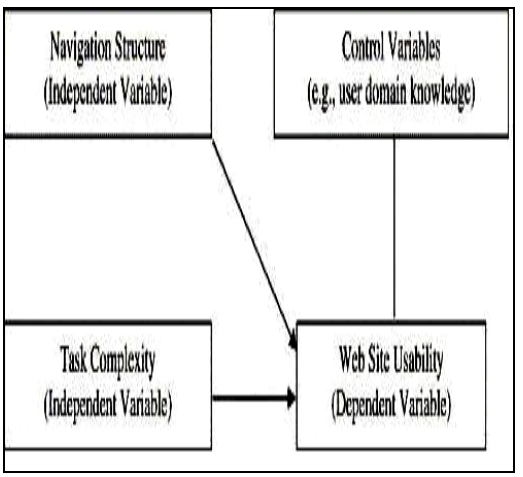


Fig. 1. Research Model

This paper mainly examines the following questions of how to improve user navigation in a website with quite number of small changes to its existing structure. It complements the literature of transformation approaches that focus on reconstructing the link structure of a website. As a result, our proposed new MP model is very much suitable for website maintenance and the same can be applied in a regular manner.

3. Metric for Evaluating Navigation Effectiveness

In this section, we mainly discuss about the important metrics that were used for evaluating navigation effectiveness.

3.1 The Metric

Our main objective in this paper is to improve the navigation effectiveness of a website with quite number of small changes to its existing structure. Thus, a well structured website should be organized in such a way that the difference between the website structure and users' expectation of the structure is always minimized. Since each and every user of various information based web sites have some information targets [9, 12, we measure this difference by the number of times a user has attempted to identify before locating the target.

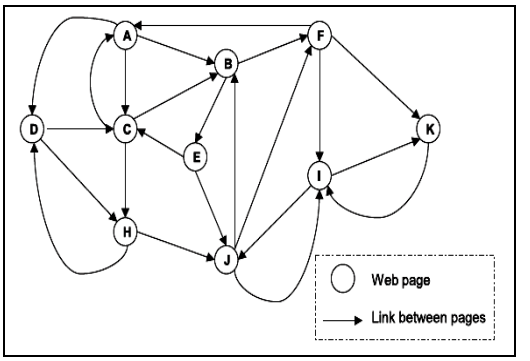


Fig. 2. A Website with 10 Pages

3.2 An Example

We use an example to illustrate the above mentioned concepts and how to extract the following metric from weblog files. In order to analyze the interaction between web users and a website, the user log files must be broken up into user sessions. One of the author named Cooley et al. [4] define a session as a group of user activities like login and log out during his visit to the site. In this definition, a session may include more than one target pages with in a single session .Since the main metric which is used in our proposed analysis is the number of paths travelled to find one target page with another target page, for that reason we use a different term known as **mini session** which refers to a group of pages visited by a user for only one target. Thus, a session may contain more than one e mini sessions, each of which comprises a set of paths traversed to reach the target.

4. Our Proposed MP Model

In this section, we mainly discuss the notations that are used for our proposed MP model for facilitating effective user navigation through website structure improvement.

4.1 Mini Session and Target Identification Metrics

In this paper, we employed the page-stay timeout heuristic methods to identify users' targets and to describe mini sessions. The intention is that users spend more number of time on the target pages. Page-stay time is a common implicit measurement found to be a good indicator of page/document relevance to the user in a number of studies [14].In the context of web usage mining, the session identification [15], are mainly identified by page-stay timeout heuristic as well as other time-oriented heuristics which is shown in figure 3 with respect to variations of the threshold values [6].

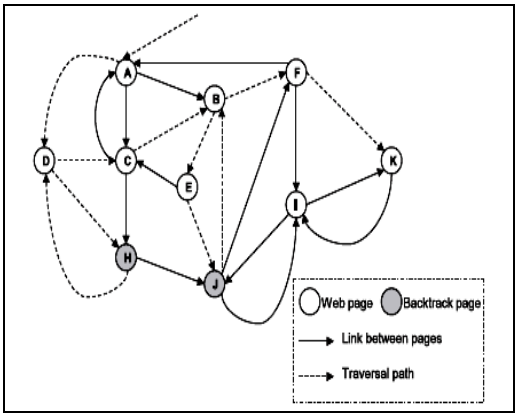


Fig. 3. Example of a mini session.

During this process the time thresholds need to be properly selected based on the amount of information displayed in the web pages. In general, we need a larger time threshold for websites that consists of information-rich pages than those whose pages contain less information. Several other approaches can also help accurately to identify the target pages. As an example, since web designers have a very good understanding of web contents, they can identify a set of important pages with high probabilities of being user as a target. Such information could greatly help to improve the accuracy of target page identification.

4.2 Differentiating Searching Sessions versus Browsing Sessions

While the majority of web users have one or more goals and search for particular pieces of information when navigating a websites ("searching" sessions), some users might simply browse for general information ("browsing" sessions). Though exact distinction between these two web surfing behaviors is often impossible by only looking at the anonymous user access data from weblogs, certain characteristics can help differentiate the two types of sessions. For example, some visits are clearly purposeless and finish abruptly at pages that cannot be target pages, so these sessions are more likely to be browsing sessions. To the best of our knowledge, there is no algorithm developed to distinguish between the two types of sessions and further investigation on this question is needed. While we did not explicitly separate searching sessions from browsing sessions, the preprocessing steps can help eliminate many purposeless browsing sessions. As a result, the final improved website structure mainly "shortens" searching sessions and also reduces purposeful browsing sessions.

4.3 Implications of this Research

This research mainly contributes to the content mentioned in this paper on improving web user navigation by examining this issue from a new and improved innovative angle. We have performed several experiments on both real data set and synthetic data sets to show that our proposed MP model can be effectively solved and is highly scalable compared with existing models. In addition, the evaluation results confirm that users can indeed benefit from the improved structure after suggested changes are applied. There are several important implications evolved from this research.

4.4 Choice of Parameter Values for the Proposed MP Model

Path threshold Parameter

The path threshold parameter represents the goal for user navigation that the improved structure should meet and can be obtained in several ways. First, it is possible to identify when visitors exit a website before reaching the targets from analysis of weblog files [4] , [8]. Hence, observations of these sessions help to make a good estimation for the path thresholds. Second, surveying website visitors can help better understand users' expectations and make reasonable selections on the path threshold values.

4.5 Evaluation of the Improved Website Structure

In addition to the extensive computational experiments on both real and synthetic data sets, we also perform evaluations on the improved structure to assess whether its navigation effectiveness is indeed enhanced by approximating its real usage. Specifically, we partition the real data set into a training set (first three months) and a testing set (last month). We generate the improved structure using the training data, and then evaluate it on the testing data using two metrics: the average number of paths per mini session and the percentage of mini sessions enhanced to a specified threshold. The first metric measures whether the improved structure can facilitate users to reach their targets faster than the current one on average, and the second metric measures how likely users suffering navigation difficulty can benefit from the improvements made to the site structure. The evaluation procedure using the first metric consists of three steps and is described as follows:

1. Apply the MP model on the training data to obtain the set of new links and links to be improved.
2. Acquire from the testing data the mini sessions that can be improved, i.e., having two or more paths, their length, i.e., number of paths, and the set of candidate links that can be used to improve them.
3. For each mini session acquired in step 2, check whether any candidate link matches one of the links obtained in step 1, that is, the results from the training data. If yes, with the assumption that users will traverse the new link or the enhanced link in the improved structure, remove all pages (excluding the target page) visited after the source node of the matching candidate link to obtain the new mini session for the improved website, and get its updated length information.

	n_1	n_2	n_3	n_4	n_5	n_6
n_1	0	0	0	1	1	0
n_2	1	0	0	1	1	1
n_3	1	1	0	0	0	0
n_4	1	1	1	0	1	0
n_5	1	1	1	1	0	1
n_6	0	1	1	1	0	0

Fig. 4. The Connectivity matrix for illustrative examples.

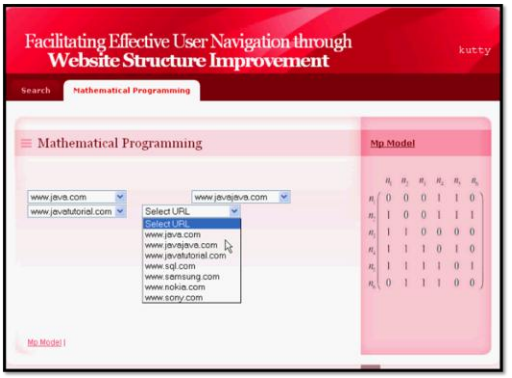
5. Experimental Results

In this section we will show the experimental results what we have observed by implementing the proposed techniques in this paper. For obtaining these results we have used Java EE as programming language for implementing this proposed new mathematical programming model for improvement of website structure for user navigation.

User Home Page

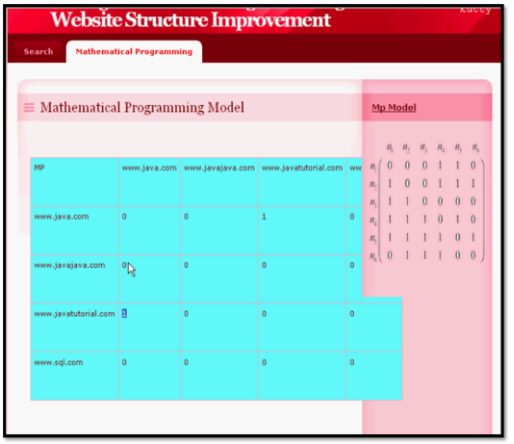
In the above web page, we can find the user navigation for a mobile, where we got the preferred data along with that we also have a web personalization and web transformation for the navigated user data.

Mathematical Programming Model Web Page



In the above web page, we can find the MP Model for the browser web pages based on the selected URL's given blinks, we will get the connectivity matrix for the selected web url's.

User Connectivity Graph Based on MP Model



In the above web page, we can find the MP Model for the browser web pages based on the selected URL's given blinks, we will find the connectivity matrix for the selected web url's after transformation process takes place.Here the matrix is represented with two values like 0's and 1's.Where Zero's indicates two corresponding URL's are not transformed each other. One's indicates that corresponding URL's or Web Site address is matched and transformed one each other in different stages.

Admin Mini Sessions Web page

In the above web page, we will find out the mini sessions status like processing, already processed into Mp Model or banned by the admin.

6. Conclusion

In this paper, we have proposed a new mathematical programming (MP) model to improve the navigation effectiveness of any website while minimizing more changes to its current structure. Our proposed MP model is particularly applied for various number of informational websites whose contents are relatively stable over time (i.e. Dynamic web sites are not possible). It improves a website rather than rearranging it and hence is suitable for website maintenance on a progressive basis. The tests on a real website showed that our proposed MP model could provide significant improvements to user navigation by adding only few new links without adding more links for the current structure. Optimal solutions were quickly obtained, suggesting that the model is very effective to real world websites. In addition, we have tested the MP model with a number of synthetic data sets that are much larger than the largest data set considered in related studies as well as the real data set.

7. References

[1] Pingdom, "Internet 2009 in Numbers," http://royal.pingdom. com/2010/01/22/internet-2009-in-numbers/, 2010.

[2] J. Grau, "US Retail e-Commerce: Slower But Still Steady Growth," http://www.emarketer.com/Report.aspx?code=emarketer_2000492, 2008.

[3] Internetretailer, "Web Tech Spending Static-But High-for the Busiest E-Commerce Sites," http://www.internetretailer.com/ dailyNews.asp?id = 23440, 2007.

[4] D. Dhyani, W.K. Ng, and S.S. Bhowmick, "A Survey of Web Metrics," ACM Computing Surveys, vol. 34, no. 4, pp. 469-503, 2002.

[5] X. Fang and C. Holsapple, "An Empirical Study of Web Site Navigation Structures' Impacts on Web Site Usability," Decision Support Systems, vol. 43, no. 2, pp. 476-491, 2007.

[6] J. Lazar, Web Usability: A User-Centered Design Approach. Addison Wesley, 2006.

[7] D.F. Galletta, R. Henry, S. McCoy, and P. Polak, "When the Wait Isn't So Bad: The Interacting Effects of Website Delay, Familiarity, and Breadth," Information Systems Research, vol. 17, no. 1, pp. 20-37, 2006.

[8] J. Palmer, "Web Site Usability, Design, and Performance Metrics," Information Systems Research, vol. 13, no. 2, pp. 151-167, 2002.

[9] V. McKinney, K. Yoon, and F. Zahedi, "The Measurement of Web-Customer Satisfaction: An Expectation and Disconfirmation Approach," Information Systems Research, vol. 13, no. 3, pp. 296-315, 2002.

[10] T. Nakayama, H. Kato, and Y. Yamane, "Discovering the Gap between Web Site Designers' Expectations and Users' Behavior," Computer Networks, vol. 33, pp. 811-822, 2000.

[11] M. Perkowitz and O. Etzioni, "Towards Adaptive Web Sites: Conceptual Framework and Case Study," Artificial Intelligence, vol. 118, pp. 245-275, 2000.

[12] J. Lazar, User-Centered Web Development. Jones and Bartlett Publishers, 2001.

[13] M. Kilfoil et al., "Toward an Adaptive Web: The State of the Art and Science," Proc. Comm. Network and Services Research Conf., pp. 119-130, 2003.

[14] J. Hou and Y. Zhang, "Effectively Finding Relevant Web Pages from Linkage Information," IEEE Trans. Knowledge and Data Eng., vol. 15, no. 4, pp. 940-951, July/Aug. 2003.

[15] H. Kao, J. Ho, and M. Chen, "WISDOM: Web Intrapage Informative Structure Mining Based on Document Object Model," IEEE Trans. Knowledge and Data Eng., vol. 17, no. 5, pp. 614-627, May 2005.

[16] R. Gupta, A. Bagchi, and S. Sarkar, "Improving Linkage of Web Pages," INFORMS J. Computing, vol. 19, no. 1, pp. 127-136, 2007.

[17] M. Eirinaki and M. Vazirgiannis, "Web Mining for Web Personalization," ACM Trans. Internet Technology, vol. 3, no. 1, pp. 1-27, 2003.

[18] B. Mobasher, H. Dai, T. Luo, and M. Nakagawa, "Discovery and Evaluation of Aggregate Usage Profiles for Web Personalization," Data Mining and Knowledge Discovery, vol. 6, no. 1, pp. 61-82, 2002.

[19] B. Mobasher, R. Cooley, and J. Srivastava, "Automatic Personalization Based on Web Usage Mining," Comm. ACM, vol. 43, no. 8, pp. 142-151, 2000.

[20] B. Mobasher, R. Cooley, and J. Srivastava, "Creating Adaptive Web Sites through Usage-Based Clustering of URLs," Proc. Workshop Knowledge and Data Eng. Exchange, 1999.

[21] W. Yan, M. Jacobsen, H. Garcia-Molina, and U. Dayal, "From User Access Patterns to Dynamic Hypertext Linking," Computer Networks and ISDN Systems, vol. 28, nos. 7-11, pp. 1007-1014, May 1996.

8. About the Authors

Devakinanda K Kiriti K is currently pursuing his M.Tech in Computer Science & Engineering Department, Kaushik College of Engineering and Technology, Visakhapatnam. His area of interests includes Computer Networking, Data Mining and Data Warehousing.

Mr. S.Venkatarao is currently working as an Assistant Professor in Computer Science & Engineering Department at Kaushik College of Engineering and Technology, Visakhapatnam. He has received Post Graduation MCA from the Department of Computer Science and Systems Engineering, Andhra University in the year 2008 and Master of Technology in the Dept of Computer Science Engineering, from JNT University. His research interests includes Computer Networking, Data Mining and Data Warehousing.