COGNITIVE MODEL FOR INFORMATION FORAGING ON WEB

Manuj Darbari[1], Gaurav Kumar Srivastava[1], Diwakar Yagyasen[1], Himanshu Pandey[2]
[1]Computer Science and Engineering, BBD University, Lucknow, India
[2]Computer Science Department,
B. N. College of Engineering Technology, Lucknow, India.

ABSTRACT
The web foragers face many problems at time of foraging information on the web. We introduced new model in the paper high lights the issue of Web Foraging application in facilitating the user's preferences and choices. The model includes the cognitive principals. The paper discusses various algorithms and develops best possible framework for buying behavior on watch website.

KEYWORDS *Cognition · Information foraging · SNIF-ACT*

I. INTRODUCTION

This paper deals with study the optimal foraging theory. It gives the idea about the foraging for information by the human search on the web it is same as animal get foods or energy during the searching of foods and they get foods on the lowest price of the searching. As OFT give a good foraging of foods for the animals a best foraging for the human search about information is depend upon the search behavioral of the human and how much users are able to understand the foraging information. For the first time Peter Pirolli and Stuart described card by developing the concept of identifying sameness of information foraging and OFT. They described both schemes as same because humans are also work like animal how search the food for eating on lowest cost and effort. Same humans are work for information foraging from navigation.

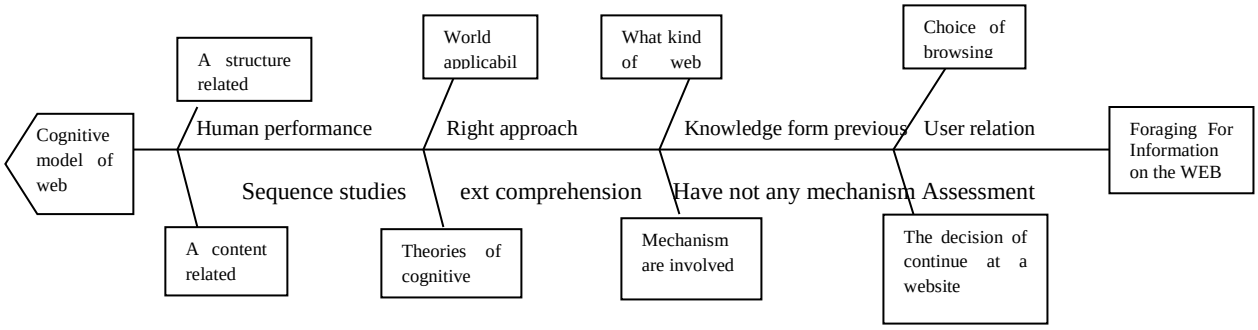

Fig. 1 Fish Bone Diagram of Cognitive Model Of WEB Navigation

For the information foraging of humans on web meaning right and accurate information for humans is very important because it give optimal and low cost of foraging so cognitive models are introduced.

II. LITERATURE SURVEY

Information foraging on web are uses many cognitive models which are give right and more effective

information, user wants to foraging. Cognitive models are mainly gate right and accurate information of the web navigation on lowest cost of foraging. Many task are involved in the navigation of the information on the web some are as evaluating web pages, search browsing, reading web pages and so many mix task which are not so simple for foraging. In this we navigate one web page to other web pages.

Many models are designed for the information foraging on the web some are such as in the given table 1 with their features. Information Theory started its concept from the foraging theory used in biology (by Stephens Kerbs, 1986). (Newell, 1985) also described foraging based on "good fit" explanation of the data posteriori. Later on (Anderson 1998, 2004) developed the concept of ACT (Adaptive Control Thought). To extend further (Bhavnani, 2005) developed this concept for medical informatics.

III. FRAME WORK

We present a new cognitive model by combining some important features of all models in one model to foraging of information on web, which is expected to give accurate information to the users searching for some information. The features which are included to this model is to create a new cognitive model for information foraging. Such as the whole-wide web as a semantic space[?,?] and predicts navigational choices (SNIF-ACT- Pirolli, Peter).The backtracking behaviour to explain the mode (MESA-C.S Miller and Reming-ton),comparison invole computing between the search and the search object (CoLiDeS-Kitajima, M.Blackmon) and mathematical technique called Latent

Table 1 Comparative Study of Information Foraging models

NAME FEATURE	SNIF-ACT (Sent-Based Navigation And Information Foraging-2003)	MESA (Method For Evaluating site Architecture - C.S Miller &Remington-2004)	CoLiDeS (Comprehension-Based Linked Model Of Deliberative search Kitajima & Blackmon-2005)	CoLiDeS + (Juvina and Oostedorp-2007)
1	This architecture considers the whole-wide web as a Semantic Space , and Predicts navigational choices .	It gives a model for explaining user backtracking behaviour .	This model assumes that comprehension of text and images is the key to web navigation.	CoLiDeS+ which extends CoLiDeS by including contextual information.
2	SNIFT-ACT was developed under the assumption that the complexity of web navigation behaviour could best be addressed by a process of successive approximation.	MESA navigates with three basic operators- Assess the relevance of a link. Select a link. Back track to previous page.	Comprehension process build elaborate and compare the mental representation of screen object to determine which hyper link or image to select and click.	CoLiDeS+ defines path adequacy as the semantic similarity b/w the navigation path and goal.
3	A parameter called information scent which is calculated as the mutual	It is intended to be a cognitive engineering model for calculating the	This comparison involves computing semantic similarity b/w the search goal and the search	It is use when incoming information from links on the current page increases

	relevance between the user goals and link texts.	time cost of navigation.	objects.	path adequacy otherwise alternate paths are chosen.
4	This model is based on the concept of semantic similarity or information.	The focus of MESA is on link navigation which empirical studies suggest is the dominant strategy for foraging for information on web.	It use a mathematical technique called Latent Semantic and analysis (LAS) developed by Landaner et al (1998).	Same as CoLiDeS the CoLiDeS+ is also use the mathematical technique (LAS).

Semantic and Analysis(LAS-Landaner et al 1998) this is one of the feature of CoLiDeS. We have combined all the essential features of these model to gener-ate an optimum framework. We use an analysis technique to evaluate foraging of the our new assumption of cognitive model as we explain above LSA Latent Semantic and analysis (LAS-Landaner et al 1998) this give result as this model give accurate and right information of human foraging on low cost of foraging. Consider a case of a website selling watches providing online shopping on low cost and best features. We go on a online website www.watch.com. In this website there are number of shown watches are present with their feature cost and trends. But which one is good for the user according to the feature, cost and trend. This is not very easy task to find accurate result for user, but this foraging of watch is possible by evaluating the new cognitive model for user is foraging task for latest watch with feature like low cost and trends. This model is evaluate semantics of the web page, comparing the foraging of user to requirement it means what is on the web page and what is search by the use

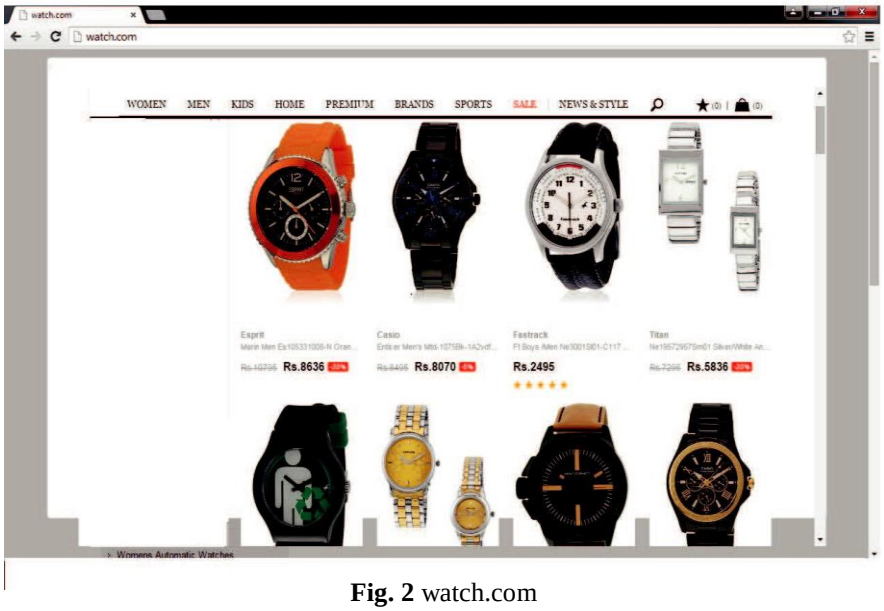

Fig. 2 watch.com

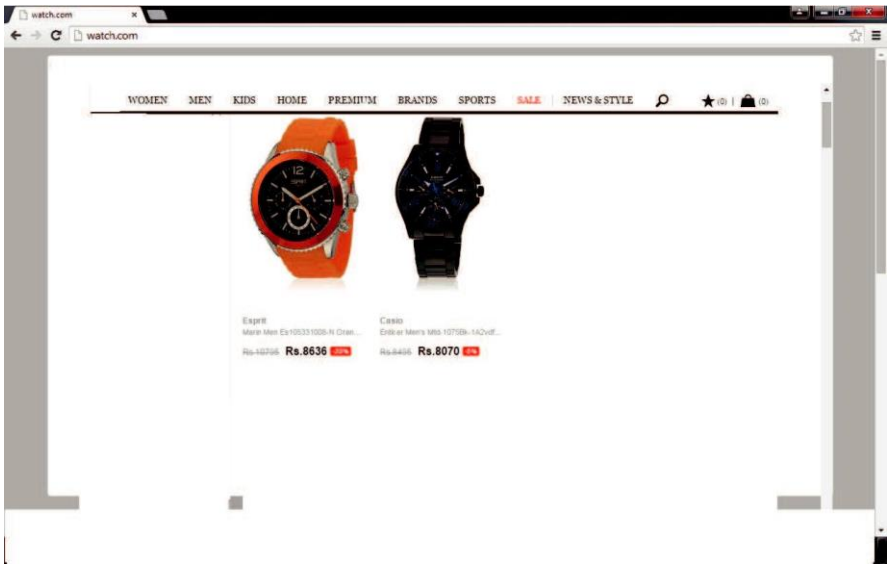

Fig. 3 watch.com

and then give accurate result back to the user according to their foraging of things such as in the above case. This model gives a comparative view to the user according to the budget, features and trends. After evaluation it shows the result which is best for the user according to the user foraging (figure 2). The new result shows only two watches are best according to the user foraging (figure 3) of watch after evaluation of all data which are present on the web page the website will give this two watches for the user. For optimizing the result we use the concept of SNIF-ACT. SNIF-ACT deals with relational analysis of web navigation. It provides two major predictions:
– Selection of link
– Behavior of the person when to change from one path to another.
In case of more than one match, the matching rule from a conflict set and a mechanism is called as "Conflict resolution". Finally the expected matching is calculated based on the utility level. The one with the highest utility level is picked up. The task goal is represented by a set of chunks. The text used for searching the items activates set of goal chunks and display chunks.
We can define the SNIF-ACT algorithm for the watch store as:
Algorithm 1 SNIF-ACT

1. procedure START PROCESS PAGE
2. if the Goal ∗ Start/ − next/ − patch
3. there is a task to load the page successfully.
4. there is a browser supporting the page
5. if the browser is on an unprocessed page
6. then Set and push a sub goal ie . The website to the goal stack.
7. end procedure
8. procedure PROCESS-LINKS-ON-PAGE
9. Load all the web links of the page
10. Attend-to-Link
11. If the goal is Goal ∗ Process − Link
12. the user has evaluated the link
13. set the link to highest Activation.
14. Read-and-Evaluate Link:
15. if the goal is Goal ∗ Process − link
16. Divert the current attention to the link
17. then Read and Evaluate the link
18. It could cost Features
19. Leave Site:
20. if the goal is Goal ∗ Process − Link interacted

21. if the user has not much on the web page
22. then leave the site pop the goal from the goal
23. stack. Backup a page:
24. if the goal is Goal ∗ Process − Link
25. the mean activation on page is low
26. Not much relevant information about the product
27. then Go back to the previous page
28. Homepage
29. end procedure

From the above algorithm we are able to prove that how we forced the model website to match with user's choice regarding the cost and features of the watch model.

IV. FUTURE WORKS

This framework can be extended in the future to search of graphical and picture information on the web. We can use this model in future for graphical information foraging on the web. This will extend into a graphical information foraging on web.

V. CONCLUSION

The paper provides a framework for information foraging of an online watch store where foraging is based on the behavior of the user of the web content forced[7,8,9]. The main idea of using information foraging is we can help the user in finding the best possible outcomes using successive approximation using SNIF-ACT which works a computational cognitive model for searching on the web.

REFERENCES

[1]. Blackmon, M.H., Polson, P.G., Kitajima, M., & Lewis, C. (2002). Cognitive Walkthrough for the Web. *2002 ACM conference on human factors in computing systems (CHI'2002),* 463-470.
[2]. Blackmon, M.H., Kitajima, M., & Polson, P.G. (2005). Tool for Accurately Predicting Website Navigation Problems, Non-Problems, Problem Severity, and Effectiveness of Repairs. *2005 ACM conference on human factors in computing systems.* 31-40.
[3]. Chi, E. H., Pirolli, P., Chen, K., & Pitkow, J. (2001). Using information scent to model user information needs and actions and the Web. *Proceedings of CHI 2001,* ACM Press, 490–497.
[4]. Chi, E., Pirolli, P., & Pitkow, J. (2000). The scent of a site: A system for analyzing and predicting information scent, usage, and usability of a website. *Proceedings of CHI 2000,* ACM Press, 161–168.
[5]. Desimone, R., & Duncan, J., (1995), Neural Mechanisms of Selective Visual Attention, *Annual Review of Neuroscience*, March 1995, Vol. 18, 193-222.
[6]. Hinesley, G.A. (2005). The impact of graphical conventions and layout location on search for webpage widgets. Unpublished Dissertation, University of Colorado, Boulder.
[7]. Hinesley, G.A., & Blackmon, M.H. (2008). The Impact of Graphics and Location Expectations on the Search for Webpage Widgets. *Workshop on Cognition and the Web*, Granada, Spain.
[8]. Itti, L., & Koch, C. Computational Modelling of Visual Attention, *Nature Reviews Neuroscience*, 2(3)194-203.
[9]. Juvina, I., Oostendorp, H. van, Karbor, P., & Pauw, B. (2005). Toward Modeling Contextual Information in Web Navigation. *XXVII Annual Conference of the Cognitive Science Society,* Stresa, Italy.
[10]. Juvina, I. & Oostendorp, H. van (2008). Modeling Semantic and Structural Knowledge in Web Navigation. *Discourse Processes,* 45(4-5), 346-364.
[11]. Kintsch, W. (1998). *Comprehension: A Paradigm for Cognition*. Cambridge University Press,
[12]. Kitajima, M., Blackmon, M.H., & Polson, P.G. (2000). A Comprehension-based Model of Web Navigation and Its Application to Web Usability Analysis. *Proceedings of CHI2000,* ACM Press, 357-373.
[13]. Landauer, T. K., Foltz, P.W., & Laham, D. (1998). Introduction to Latent Semantic Analysis. *Discourse Processes,* 25, 259-284.
[14]. Mayer, R. E. & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist,* 38, 43-52.

[15]. Miller, C. S., & Remington, R. W. (2004). Modelling Information Navigation: Implications for Information Architecture. *Human-Computer Interaction*, 19(3), 225-271.
[16]. Oostendorp, H. van, & Juvina, I. (2007). Using a Cognitive Model to generate Web Navigation support, *International Journal of Human Computer Studies, Volume 65(10), 887-897.*
[17]. Paivio, A (1986). Mental representations: a dual coding approach. Oxford. England: Oxford University Press.
[18]. Pirolli, P., & Card, S.K. (1999). Information Foraging. *Psychological Review*, 106(4), 643-675.
[19]. Pirolli, P., & Fu, W.T. (2003). SNIF-ACT: a model of information foraging on the World Wide Web. *9th International Conference on User Modeling (UM 2003);* Johnstown; PA. Berlin: Springer Verlag; LNCS 2702: 45-54.
[20]. John R Anderson. *Cognitive psychology and its implications* . WH Freeman/Times Books/Henry Holt & Co, 1990.
[21]. Sunita Bansal and Manuj Darbari. Designing and knowledge based expert system for handling business dynamics. *International Journal of Scientific & Engineering Research Volume2*, (11), 2011.
[22]. Stuart K Card, Thomas P Moran, Allen Newell, et al. The psychology of human-computer interaction. 1983.
[23]. Bhavnani, S. K. (2002). Domain-specific search strate-gies for the effective retrieval of healthcare and shopping information. CHI 2002 Conference on Human Factors and Computing Systems, Extended Abstracts (pp. 610–611). Minneapolis, MN: Asso-ciation for Computing Machinery Press.
[24]. M Darbari, B Karn, V Kr Singh, and S Sayeed Ahmad. Integrating natural language requirements and open process activity theory model for platform independent web mod-eling. *International Review on Computers & Software*, 3(3), 2008.
[25]. Manuj Darbari, Rishi Asthana, Hasan Ahmed, and Neelu Jyoti Ahuja. Enhancing the capability of n-dimension self-organizing petrinet using neuro-genetic approach. *Inter-national Journal of Computer Science Issues (IJCSI)*, 8(3), 2011.
[26]. Franca Garzotto, Maristella Matera, and Paolo Paolini. Model-based heuristic evaluation of hypermedia usability. In *Proceedings of the working conference on Advanced visual interfaces*, pages 135–145. ACM, 1998.
[27]. David Klahr, Pat Langley, and Robert Neches. *Production system models of learning and development*. MIT press, 1987.
[28]. Thomas K Landauer and Susan T Dumais. A solution to plato's problem: The latent semantic analysis theory of acquisition, induction, and representation of knowledge. *Psy-chological review*, 104(2):211, 1997.R Duncan Luce. *Individual choice behavior: A theoretical analysis*. Courier Corporation, 2005.
[29]. Fu, W.-T. (2007), Adaptive Tradeoffs between Explorationand Exploitation: A Rational-ecological Approach.Exploitation: A Rational-Ecological Approach. In Gray,W.D. (Ed), Integrated Models of Cognitive Systems,Oxford: Oxford University Press.. In Gray, W.D. (Ed),*Integrated Models of Cognitive Systems*, Oxford: OxfordUniversity Press
[30]. .McFadden, D. (1978). Modelling the choice of resi-dential location. In A. Karlqvist, L. Lundqvist, F.Snickars, & J. Weibull (Eds.), Spatial interactiontheory and planning models (pp. 75–96). Cam-bridge, MA: Harvard University Press.
[31]. D.I.K. Sjøberg, T. Dyba°, B.C.D. Anda, and J.E. Hannay, "BuildingTheories in Software Engineering," Guide to Advanced Empirical Software Eng., pp. 312-336, Springer, 2008.
[32]. M. Kersten and G. Murphy, "Mylar: A Degree of Interest Model for IDEs," Proc. Aspect-Oriented Software Development Conf., 2005.
[33]. A.J. Ko, B.A. Myers, M.J. Coblenz, and H.H. Aung, "An Exploratory Study of How Developers Seek, Relate, and Collect Relevant Information during Software Maintenance Tasks," IEEE Trans. Software Eng., vol. 32, no. 12, pp. 971-987, Dec. 2006.
[34]. M. Robillard, W. Coelho, and G. Murphy, "How Effective Developers Investigate Source Code: An Exploratory Study," IEEE Trans. Software Eng., vol. 30, no. 12, pp. 889-903, Dec. 2004.
[35]. Pirolli, P. and S.K. Card, *Information foraging.* Psychological Review, 1999. **106**: p. 643-675.
[36]. Anderson, J.R. and C. Lebiere, *The atomic components of thought*. 2000, Mahwah, NJ: Lawrence Erlbaum Associates.
[37]. Pirolli, P., et al. *A user-tracing architecture for modeling interaction with the World Wide Web*. in *Advanced Visual Interfaces,AVI 2002*. 2002. Trento, Italy: ACM Press.
[38]. Pirolli, P., *Cognitive engineering models and cognitive architectures in human-computer interaction*, in *Handbook of applied cognition*, F.T. Durso, et al., Editors. 1999, John Wiley & Sons: West Sussex, England. p. 441-477.
[39]. Lynch, G., S. Palmiter, and C. Tilt. *The Max model: A standard web site user model*. in *Human Factors and the Web*. 1999.
[40]. Card, S.K., T.P. Moran, and A. Newell, *The psychology of human-computer interaction.* 1983, Hillsdale,

New Jersey: Lawrence Erlbaum Associates.
[41]. Pirolli, P., *A web site user model should at least predict something about users.* internetworking, 2000. **3**.
[42]. Byrne, M.D., et al. *The tangled web we wove: A taskonomy of WWW use*. in *Human Factors in Computing Systems, CHI '99* 1999. Pittsburgh, PA: ACM Press.
[43]. Blackmon, M.H., et al. *Cognitive Walkthrough for the Web*. in *Human Factors in Computing Systems, CHI 2002*. 2002. Minneapolis,MN: ACM Press.
[44]. Pirolli, P. *Computational models of information scent-following in a very large browsable text collection*. in *Conference on Human Factors in Computing Systems, CHI '97*. 1997. Atlanta, GA: Association for Computing Machinery.
[45]. Harman, D. *Overview of the first text retrieval conference*. in *16th Annuam International ACM/SIGIR Conference*. 1993 Pittsburgh, PA: ACM.
[46]. Card, S., et al. *Information scent as a driver of Web Behavior Graphs: Results of a protocol analysis method for web usability*.in *Human Factors in Computing Systems*. 2001. Seattle, WA.
[47]. Morrison, J.B., P. Pirolli, and S.K. Card. *A taxonomic analysis of what World Wide Web activities significantly impact people's decisions and actions*. in *Conference on Human Factors in Computing Systems, CHI '01*. 2001. Seattle, WA: ACM Press.
[48]. Ericsson, K.A. and H.A. Simon, *Protocol Analysis: Verbal reports as data*. 1984, Cambridge, MA: MIT Press.
[49]. Reeder, R.W., P. Pirolli, and S.K. Card. *Web-Eye Mapper and WebLogger: Tools for analyzing eye tracking data collected in web-use studies*. in *Human Factors in Computing Systems, CHI 01*. 2001. Seattle, WA.
[50]. McFadden, D., *Conditional logit analysis of qualitative choice behavior*, in *Frontiers of econometrics*, P. Zarembka, Editor.1974, Academic Press: New York.
[51]. McFadden, D., *Modelling the choice of residential location*, in *Spatial interaction theory and planning models*, A. Karlqvist,et al., Editors. 1978, Harvard University Press: Cambridge, MA.
[52]. Bhavnani, S.K. *Domain-specific search strategies for the effective retrieval of healthcare and shopping information*. in *Conference on Human Factors nd Computing Sytems*. 2002. Minneapolis, MN: ACM Pres

AUTHORS

Manuj Darbari was born in Lucknow, India, in 1970. He received the Bachelor in engineering degree from Amravati University, Maharashtra, India, in 1993 and the Master in engineering degree from Allahabad University, Allahabad ,India in 1995, firts one in Electronics Engineering and Master's in Digital Systems. He is At present working as Associate Professor in Department of Computer Science, BBD University, Lucknow, Utter Pradesh, India

Gaurav Kumar Srivastava was born in Varanasi, India, in 1987. He received the Bachelor in Technology degree from Utter Pradesh technical University, Lucknow, India, in2010 and Know douing the Master in Technology degree from BBD University, Lucknow, India. First one in Information Technology and pursuing Master's in computer science.

Himanshu Pandey was born in Lucknow, India, in 1990. He received the Bachelor in Technology degree from Amity University, Lucknow, India, in2012 and the Master in Technology degree from BBD University, Lucknow,India in 2014 . First one in Information Technology and Master's in computer science. He is At present working as Assistant Professor in Department of Computer Science, B. N. College of Engineering Technology, Lucknow, Utter Pradesh, India

Diwakar Yagyasen was born in Lucknow, India. He received the Bachelor in Technology degree from Utter Pradesh technical University, Lucknow, India, in 1998 and the Master in engineering degree from KNIT Sultanpur, India in 2008, First one in Computer Science & Engineering and Master's in Electronics Engineering. He is At present working as Associate Professor in Department of Computer Science, BBD University, Lucknow, Utter Pradesh, India