13 AN ARTIFICIALLY INTELLIGENT RECOMMENDER FOR ENHANCING USER'S BROWSING EXPERIENCE

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This paper is a depiction of how user experience, while interacting with a product can be improved by identifying the user's choices based on their behaviors and reactions while interacting with a display. The paper describes the design and development of a news intelligent recommender system for the website www.timesofindia.com. The new system first identifies user behavior unobtrusively, and then interprets the behavior by understanding the design patterns and re- configures the visual placement of the information on the display screen to suit the habitual preferences of the user. The recommender system suggests the changes by altering the Information Architecture of the website or the arrangement of design elements on the web interface.

The aim is to ease the user's interactive experience that may be due to information overload and visual clutter. It makes it possible to give the user what he/she is looking for in terms of priority.

Keywords: User Behaviors/interaction Patterns, Internet, Eye tracking, Recommender System, Information Architecture (IA).

1. INTRODUCTION

Every day we have millions of new WebPages added on to the internet. Websites with large information systems attract millions of users every day. Good information architecture that is modeled on the user's needs helps the users to locate their desired information easily. Once the layout of a page is fixed the Information architecture (IA) remains fixed. The rigidity of IA influences the user's experience on many levels-differently. There are many types of users, Expert (frequent), familiar and novice (new) which further makes the matching of IA to user's habits complex. On the other hand a fixed, standardized IA helps new users to understand the system easily but once familiarity grows the rigidity of IA may create many problems causing frustration, boredom and irritation especially amongst expert users.

This raises a new challenge to the service providers in their efforts to retain users from going away to a competitor's site.

2. CURRENT STATE OF ART

Most of the recent users of recommender system are websites like www.amazon.com or www.ebay.com which are based on collaborative ranking or other methods. These recommender systems provide the users the highly rates articles at their clicks. But there have been very less attempts to generate Recommender systems where recommendation is being used to enhance the user experience and is based on the behavior of specific user on the website.

3. NEED FOR INNOVATION

In order to improve the user experience in real time there is a need to understand dynamically the way a user is browsing through any website and to redesign the website so that he can browse more intuitively. So there needs to be a system which can generate recommendations on which the elements of design such as grid, layout, composition of a display can change and mach the user's experience in real time.

4. IMPLEMENTATION

The process and methodology for research is discussed below.

4.1. Website Chosen for Study

The product chosen to be observed during usage was the timesofindia.com website. It is a news-website which caters a very large number of users across the country and provides them with news updates every day. The news paper — Times of India is also widely accepted and read in India. In initial local survey and observation heuristics during our project, it was noticed that every individual has his/her own style of reading the newspaper. That means he has his own behavior profile for how to interact personally with the news paper.

In order to make a recommender system it was thus necessary to recommend the user the experience which suits best to his behavioral needs. Further in that process we designed the following experiment and proved the existence of the behavior patterns.

4.2. Experiment Design Result and Analysis

We conducted an experiment using Tobi eye tracker on the website www.timesofindia.com. In the experiment 28 users volunteered. All these users were regular users of this news website. These users browsed the website, as they daily do- to read the news, under controlled conditions in the lab. We recorded their navigation on this website for five different days to know their generalized behaviour over time to the particular test website. We also conducted personal post activity interviews with these users to know more about their behavior.

4.3. Users

All the users were regular habitual users of the selected web page. They were of the age range of 19 to 25 years. The uses were asked to browse through the News Website as though in their normal daily browsing environment for five different days and their sessions were continuously observed and recorded. Using capture software and also with a video camera. Each session was of twenty to thirty minutes duration. The data was analyzed and yielded useful information about the likes and dislikes of a particular user, their preferences for specific news items and their patterns of interaction.

The sample set of users who volunteered for our experiment were randomly chosen and were from different parts of our country with different ethnic backgrounds with wide variability in their preferences. We had a set of twenty eight users who performed the session for five days each, these users were regular users of the website timesofindia.com and were very frequently using it.

4.4. Data Collected

The users were asked to go through the website and were monitored through the eye tracker. These sessions were recorded from one user for five continuous days. This helped us to collect us data in three forms. The Heat maps, the Gaze plots and the Video of their viewing sessions.

The Heat maps generated from EMR gave us understanding that where all did user sees most. The Gaze plot helped us to understand the sequence of viewing of the user on all five different occasion. And the video recorded were used for supporting post usage interview content analysis.

Figure 1. Photo showing users who volunteered for experiment.

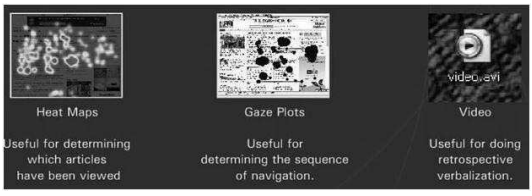

Figure 2. Figure showing three different forms of data collected by experiment.

Figure 3. Figure showing patterns in data collected by experiment for one user.

This all data analysis led us to the conclusion for the existence of patterns in the way a user used the website.

4.5. Result and Analysis — Existence of Patterns

The results indicated the existence of unique behavior patterns in users while using the website. The idea is already published as a paper. *[1.VikasVaishnav and Pradeep Yammiyavar, Identifying Patterns in User's Preferences and the role of culture behind it — a case study of News Website. Working paper, May 2007, DoD IITG., Guwahati.*] From a fixed threshold value of the interaction parameters our algorithm could find out that which article is read by the user. When his reading behavior was studied it was observed that some patterns exist in his reading style.

These behavior patterns were used to develop a profile of the user which in turn was used to make recommendations to the user via software written for the purpose. These behavior patterns could be identified only if the amount of interaction a user is performing with the product is measured which defined our next task to measure the interaction performed with the website.

5. NEED FOR METHODS TO MEASURE INTERACTION

5.1. Modes of Interaction Observed

Interaction of users with computers is multi-modal; it involves three kinds of interactions

- Mouse Based
  - Cursor Movement
  - Clicks
- Keyboard Inputs

- Eye Movement (Visual Perception)

It was the measurement of these interaction parameters during the user's navigation which gave us the idea that which article was being read by the user. A list of such read articles would determine the patterns and thus behavior profile of the user.

6. DEVELOPMENT OF INTERACTION EQUATION

6.1. Equation Generation

By keen observation and analysis we came down to certain factors which can be termed as major variables affecting the Activity a user performs on the website. It is our assumption and may be different for different platforms to access the webpage. Interaction Activity is a vague term and is difficult for machine to understand. For recommendation we required that a machine should understand the interaction performed on a particular page hence we had to quantize the interaction. For this we coined a term a known as the Interaction Activity and found out that the term is dependent on certain variables which are also sources of interaction. Based on observation of experimental data it is our assumption that the activity is dependent on these four variables –

- The Mouse Movement - (M) - The quantity is specified by a capital M. It means the amount of mouse pointer movement over the article being read. It can be easily measured by java script. This quantity is a parameter that helps us to measure the interaction mathematically and makes it easier for computer to understand the meaning of interaction.

Generally it was observed in experiments conducted that the particular article being read facilitates lots of clicking and mouse pointer movement over the article. This helps us to determine to an extent that whether an article has been read or not. So M is directly proportional to the Interaction Activity.

$$A \alpha M \tag{1}$$

Where A = Interaction activity and M = Mouse pointer movement.

- The Mouse Clicking - The quantity is expressed by C. As discussed above the particular quantity is also an indication of an interaction performed on that particular article page. The number of clicks both relevant (links based) and irrelevant can be a distinguishable parameter of interaction which tells us whether a particular article has been read by the user or not. So C is directly proportional to the Interaction Activity

$$A \alpha C \tag{2}$$

Where A = Interaction activity and C = number of Clicks.

- The Time of Viewing - The quantity is specified by (T) and it means the amount of time a particular article page has been viewed. This interaction parameter is generally important at areas of website where only one article is there on one webpage. So time of the particular web page viewing can be recorded. And that gives us important data of whether that particular article has been read or not. So T is directly proportional to the Activity

$$A \alpha T \tag{3}$$

Where A = Interaction activity and T = Time of viewing

- The Eye Movement — The interaction parameter is represented by E. However it is difficult to track eyes movement on a particular webpage in current technological scenarios publically but very soon the technology shall be available locally. With the laptops like face recognition techniques of Lenovo it is not far when eyes could be tracked easily.

This parameter can act as a major source of how an interaction on a particular page can be measured. Areas can be defined on a particular page and if the eyes of users are seeing visual fields or that particular area the time related to that area is recorded. So eye movement on a particular article is an important measurement of whether a particular article is seen or not.

$$A \alpha E \tag{4}$$

Where A = Interaction activity and E = amount of eye movement.

So E of a particular article is directly proportional to the interaction activity of the article. Taken all the parameters together we deduce the general equation of Interaction activity measurement. This equation can act as a parameter of how to measure interaction of a user mathematically and would subsequently help in recommending the changes.

The equation based on our research is dependent on basic interaction parameters. And various kinds of recommender systems can be generated based on the number of interaction parameters taken.

The equation thus will depict the observed relationship between the parameters of interaction and the amount of Interaction performed by the user. The Equation of Interaction is formulated as:

$$A \propto E.M.C.T \tag{5}$$

This equation represents a criterion for the algorithm. By measuring activity 'A' we can determine whether the person has really read the article or not. This further helps in identifying and creating the profile of user's likes and dislikes over time which our recommender system recommends back to user appropriately.

7. DEVELOPMENT OF PROTOTYPE OF RECOMMENDER SYSTEM

7.1. Working of System

System Design — System can be understood as a linear process of these steps.

- User Interaction with the website
  The whole process starts with this step. User interacts with the website over a period of time and develops a pattern. After sufficient numbers of interaction, the interaction is more or less repetitive in nature and tells us about the specific choices made by the user which recur again and again, and constitute the interaction pattern.
- Modes from the interaction
  To understand the whole process of interaction, important aspect is to learn about the modes of interactions and how they come together and give rise to interaction patterns. Mouse interaction (clicks and cursor movement), visual perception (eye movement) are the two important modes of it, along with them time brings another dimension and plays an important role in formation of interaction patterns.
- Interaction measurement
  Measurement of interaction can be done by measuring interaction associated with each mode. Eye movement can be measured in terms of x-y coordinates, an interface can be divided into different zones and time of interaction with each zone is measured by plotting the x-y coordinates of eye gaze along with time line. Similarly cursor movement can be quantified in terms of time and area. Click can be registered and give us the location of the webpage. To find whether an article has been read or not can be done by finding the threshold value with each mode of interaction (according to the role of that mode in that interaction).
- Interaction Patterns
  To find the interaction patterns, we measure the components of each interaction day by day and compare them to filter the desired information which forms the interaction pattern. Preferences (which satisfy the threshold values) of each day are tabulated and compared. We need sufficient numbers of interaction to find the pattern, this number depends on the information system (website) under consideration. Comparison of each day's preferences give us the common choices which are repetitive and constitute the recommender system.
- Recommendations
  From these patterns recommendations are made to make changes in the interaction which can enhance user experience. A set of guidelines should be developed to govern the whole system

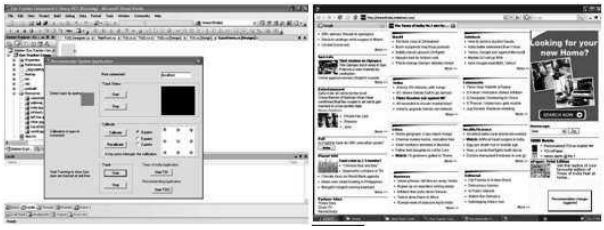

Figure 4. Photo showing snaps of application developed.

7.2. Demo Prototype Generated

7.2.1. Concept Generations

Different kinds of recommender system can be developed by taking different combinations of M, C, T, and E. Each combination gives rise to a different recommender system. Selection of the final combination depends on the information system, user requirements and technical feasibility. In the e following chart we have mentioned the different possible combinations.

To show the concept of system actually working we decided to make two demo concepts. Both these demo concepts are based on our basic equation of measurement. To show the concept working at real-time we had decided to reduce the threshold time required to suggest recommendation in real time.

We developed these two applications –

1. Eye tracker Application — This application is demo software made on c# on .net platform. To explicitly demonstrate the functioning of these basic parameters we decided to show the actual use of eye tracking variable in our test case of timesofindia.com. This application demo works when the eye tracking hardware is connected with the computer. The application tracks the article seen by you at real time. And suggest the preference order by measuring the activity parameter 'A' from the equation (4). In short we took only one of the parameter that is the eye movement in to account and developed a small example of recommender system to suggest the changes.

   In this context we developed an application interface similar to that what our users had seen during browsing the timesofindia.com website.

   Functioning: This application was shown as a prototype to a group of examiners to demonstrate the practical use of the concept shown above. This application works in two phases. The first screen shows how this application calibrates the eye position of the user with respect to the screen. And the second screen shows a list of article from timesofindia.com which a user reads. Now after reading through the articles the application rearranges the articles in the user's preference order at real time. This shows how the algorithm is able to detect in real time that what were the user's likes and dislikes while reading through the article.
2. Clicks based Application — It is another demo application developed to show the preference order at real-time based on the number of clicks done on the system.

   Functioning: This application again works similarly and was tested with the same group of examiners. This application works with a java script code. This code can be pasted in any of the webpage. It measures the number of clicks on the number of articles displayed on interface and helps in determining the activity parameter 'A'.

8. CONCLUSION

This research & design (R&D) reported in this paper is an attempt to not only conceptualize a new system but also develop a method to measure user Interactions using non intrusive methods. It has provided us a great opportunity to understand the interaction a user performs with the website with deep involvement. It was observed that certain usage patterns exist during interactions when users interact with an information system. However they need to be captured over a sufficiently long period

Figure 5. Photo showing snaps of application developed.

of time. These patterns represent the recurring choices made by the user. And are thus representative of their interacting habits. Out of 28 users we found the repetition of choices occurs in 25 profiles. It is posited that these patterns depend on two variables

1. Design of the information system, i.e. information architecture of the system and Graphical interfaces of the system.
2. Characteristics of user's behavior, i.e. Psychological, demographic, ethnographical and situational context.

To identify the patterns threshold values of amount of interaction depends on the information system. It is posited here that 6–14 cycles of interaction are sufficient to notice the existence of pattern for all kinds of information systems.

Equation of Interaction Activity attempted to be developed in this paper are an attempt to measure the Interaction the user performs on the website interface of a news web site. It depends on four variables: the eye movement over interface, the mouse pointer movement over interface, the time of viewing and the clicks performed on the article page. A sample experience enhancer application was generated to show the working of system at real time. This paper attempted to contribute to the knowledge base in the emerging discipline of Usability Engineering.

The limitations of the research are its small sample size of the users.

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