DYNAMIC BOOK RECOMMENDATION MODEL FOR REAL BOOKSTORES

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Abstract: We propose a model for finding an appropriate book and detecting an opportunity for recommendation in real bookstores. Since the models are created using a Bayesian network, dynamic personalization can be provided to users. An evaluation is performed for a system that recommends physical books based on the model, and the result is described.

1 Introduction

In recent years, researches on pervasive computing have increased the realizability of a system for recommending books in offline real bookstores. An offline recommender system is different in some ways from an online one such as amazon.com [3]. Because a real bookstore has space limitations in displaying books, the number of books to be used for recommendations is comparatively small. Moreover, user behavior in browsing books in real bookstores can be recognized through some ubiquitous devices. We consider these characteristics and propose a more complex recommendation model that handles user behavior as an input and its states are dynamically changed based on the input. Furthermore, the system uses the model to decide whether to make a recommendation.

For these reasons, we propose a model based on a Bayesian network. There are some recent researches on recommender systems using Bayesian approaches [1, 2]. The main difference between these models and our model is that a part of our model is automatically created from an Internet repository such as amazon.com Web Services.

2 Dynamic models for book recommendation in offline bookstores

Figures 1 and 2 show the initial prototypes of the model. In these figures, a single-line circled node represents a discrete node whose states are discrete. A double-line circled node represents a continuous node that handles a normal distribution according to a conditional probability table. An arrow represents a probabilistic dependence between nodes.

Figure 1 shows an example of a model for finding an appropriate related book. The model is called "WHICH" in this paper. The interest level for a book and the ratio of acceptance of the recommended book are represented as nodes that are nodes 1 and 2 in the case of BOOK 1. The relation between interest levels of two books is represented as a node, for example, nodes 7 and 8. The structure of the model is automatically developed using the information on related books, which is obtained from Amazon E-Commerce Service (http://aws.amazon.com/). The figure also shows an example of probabilistic inference. When a user requests a book related to BOOK 2, the evidence is set to node 3. The probabilities of each nodes after probabilistic

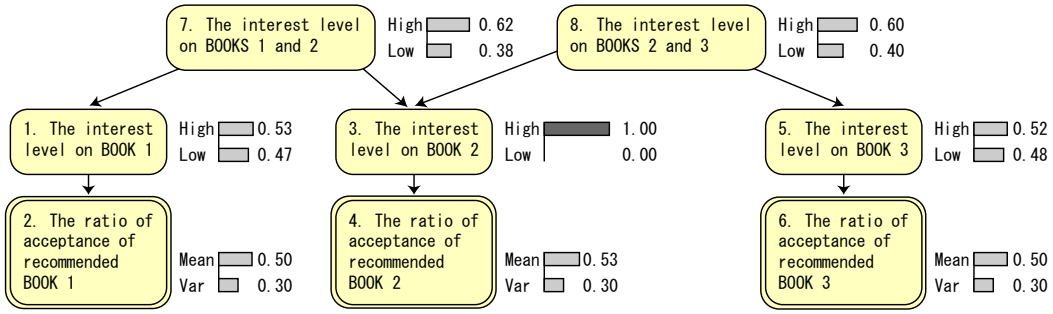

Figure 1: This is an example of a model for finding a related book. The figure shows the probabilistic inference when there is evidence that BOOK 2 is of interest.

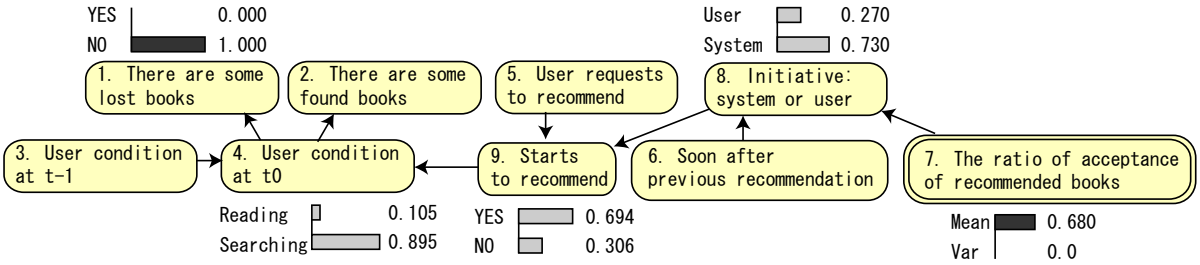

Figure 2: This is the model for detecting an opportunity to recommend a book. The figure depicts the probabilistic inference when the two evidences ("There is no book with unmeasurable position" and "The ratio of received books is 0.68") are observed.

inference are shown in the figure. In this case, BOOK 1 is the most appropriate and related book because the "High" condition of node 1 is higher than that of node 5. However, if the user does not accept BOOK 1 when it is recommended, the evidence is set to node 2. If the value is 0.0, the "High" conditions of the interest level node of BOOKS 1 and 3 assume values of 0.505 and 0.520, respectively. Therefore, the most appropriate and related book is BOOK 3 for being recommended next to the user. Dynamic personalization for recommending books is realized in this way.

Figure 2 shows the model for the detection of opportunities to make a recommendation. We created the model by using domain knowledge. The system makes a recommendation automatically and manually (user requests a recommendation) based on the model. When the probability of the YES condition of node 9 is greater than some user-selected limit, the system starts to recommend. We consider three problems to create the model. (1) User condition: When the user is reading a book, the system may not start recommendation to avoid interruption. In contrast, when the user is searching for some books, the system introduces a book to the user automatically. (2) User request: The system reacts immediately when the user requests a recommendation. (3) Initiative: If a user enjoys automatic recommendations, the system will recommend many times. Otherwise, the system will recommend only a few times. These problems are represented by nodes {1,2,3,4}, {5}, and {6,7,8}, respectively. The user condition is inferred from the previous own probability and a position detection device that is employed in the system to detect positions of books. User request is received from

Figure 3: The system for recommending related physical books using a spot of light is constructed in order to evaluate the proposed model.

passive RFID reader that reads its tag put in books. Initiative is inferred from the ratio of acceptance of recommended books and the time interval between the recommendations.

3 The system for recommending related physical books

We construct a system for recommending appropriate physical books in order to evaluate the proposed model. The system is an extended version of the system for finding lost objects [4]. An overview is shown in figure 3. When the user picks up a book and holds a PDA over it, additional information such as customer reviews and recommended books related to the selected book is shown on the PDA screen. When the user drags the spotlight icon and drops it on a related book, the physical book is illuminated by a spot of light.

Ultrasonic sensors detect the position of a book. They determine which books the user picks up. The PDA receives additional information on a book through a network when a passive RFID reader embedded in the PDA reads a tag that is placed in the book. The system illuminates the related book by using Movinglight, which is normally employed in stage lighting. Two Bayesian networks are constructed using Hugin (http://www.hugin.com/), which is a product for developing a Bayesian network. The sensors, Movinglight, and the Bayesian networks are controlled by one Windows XP PC. The PC collects book information from amazon.com to compile additional information and create Bayesian networks before an operation.

4 Initial experiment

In the evaluation, we first focused on "WHICH" model. A participant is in front of a bookshelf and browses through some books. A task to provide a simple summary on the books is performed during the browsing for keeping the participant motivated. Before and after the browsing, the participant is asked his/her magnitude of interest (from 1 to 7; increasing values represent increasing magnitudes of interest) on each of books. One participant performs browsing three times using different support systems and different sets of books; each set consists of eight books. The first system is the one employing proposed model. The second is identical to the first system without "WHICH" model that is randomly constructed. The other

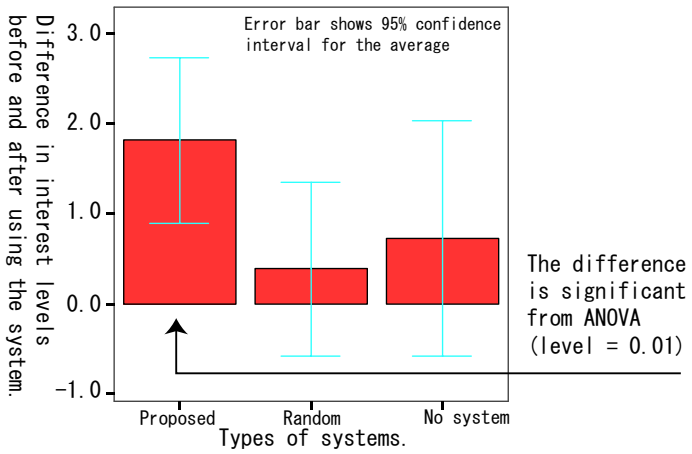

Figure 4: The difference in the interest level before and after using the system.

is not a system, and thus a participant reads books normally. Totally, twenty-one participants are examined. We consider that the magnitude of interest of the participants increases if they are aided by a system that recommends appropriate books.

The average of intra-subjects differences (before and after browsing) are shown in figure 4. The magnitude of interest increases in all the participants when they use the proposed system. The random system case is not better than the case without a system in which participants read books normally. Only the system with the proposed model has a difference in interest level that is significantly different from ANOVA (level = 0.01).

Many users who attempted to use our system confirmed that the system helped in enjoying book browsing. A subject stated that the system could be an excellent shop assistant because related physical books were introduced in succession. However, some subjects felt that the basis for the selection of a recommended book was not clear.

5 Conclusion and future works

From preliminary experiments, the model appears to contribute to an increase in the magnitude of interest in books. The problems to use the model in a real situation are to attach some devices to all books and to the environment. Further, we intend performing a more sophisticated evaluation of the model.

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