HDRS DEVELOPMENT METHODOLOGY

Ontology Design

In the execution of our approach, an ontology of Nigerian destinations was developed, which was a semantic representation of facts about five social attributes of major Nigeria destinations. Our conceptualisation of a Nigerian destination is illustrated with the semantic graph shown in Figure 2. A conceptual taxonomy of Nigerian destinations was developed consisting of three class abstractions: City, Town and Village, with *'ISA'* relationships. The five social attributes have been modelled as properties of a destination using *'FeatureOf'* association. The relationship between the different destination subclasses has been represented using *'PartOf'* association, whereby Villages and Towns are conceived as extensions of specific City destinations. In order to promote ontological reasoning, semantic relationships that exist between different instances of specific social attribute classes have been modelled with the *'CloserTo'* association. For example 'Hot Weather' is specified as symmetrically closer to 'Very Hot Weather', in order to provide adequate basis for reasoning about entities represented in the ontology. The Nigerian City ontology was implemented as an Owl ontology using the Protégé Ontology editor. The ontology consists of five disjointed classes namely: Destination, CrimeRate, Weather, Traffic, Status and Scenery. Three other classes: Town, City, Village were modelled as subclasses of Destination. The Ontology consists of facts about instances (represented as individuals in Protégé) of 37 Nigerian cities and 100 towns and villages.

Implementation Details

The HDRS prototype was implemented in Java and exploits the Java Servlet technology, running on Sun Application Web Server 9.0. The tourism asset database was implemented in MySQL, which exploits the JDBC Connector. Data on tourism assets were collected from the Nigerian Tourism Development Corporation (http://www.nigeriatourism.net). The web client interface was implemented using Macro Media Flash and Dream Weaver web design tools, and Java Server Pages (JSP) was used as server-side web development tool. Protégé 3.3.1 was used as the ontology development tool (http://protege.stanford.edu/), while Pellet 1.5 (http://pellet.owldl.com) was used as the Descriptive Logics (DL)

reasoner for the ontology. The Protégé Java AP1 was used with the NetBeans 5.5.1 Java development environment to trigger desirable ontology querying and reasoning functionalities. Figures 3,4 and 5 are snapshots from our implementation.

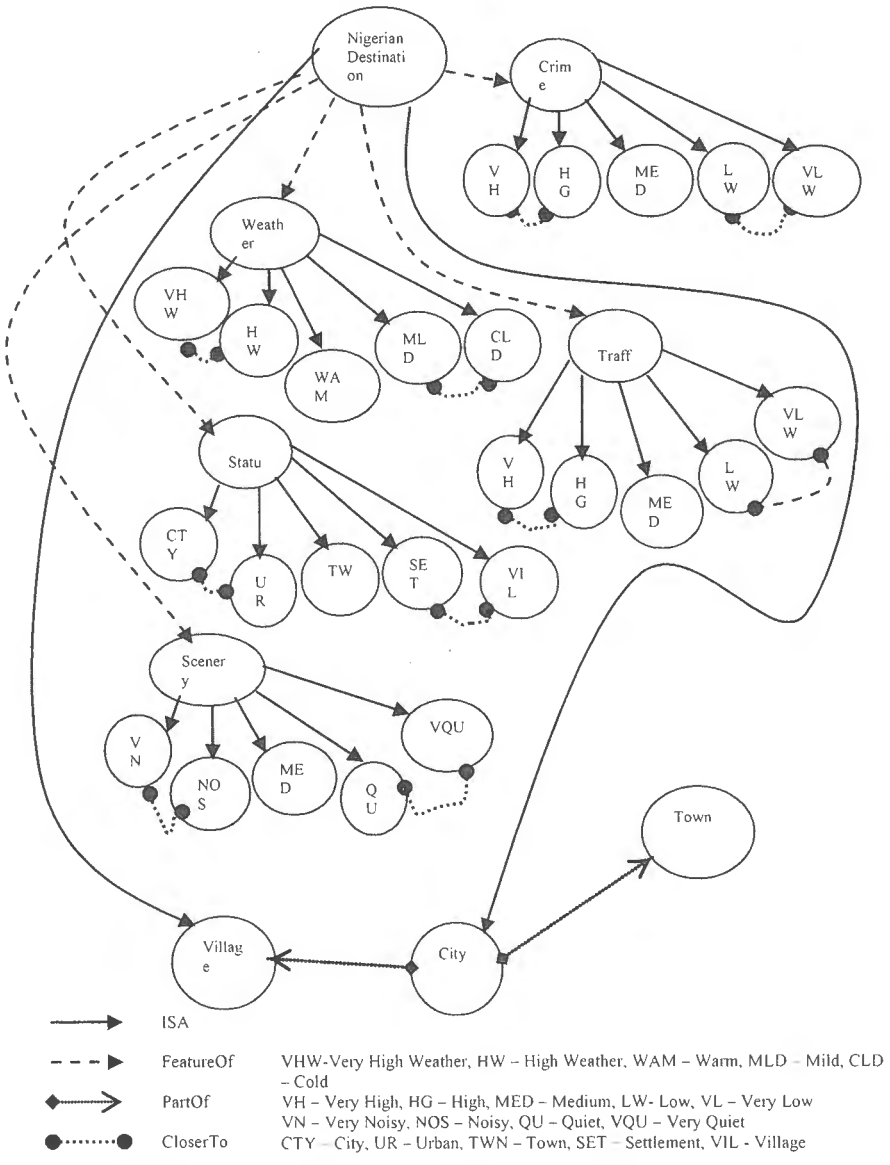


Figure 2. A Graph of the Nigerian City Ontology

EMPIRICAL USABILITY EVALUATION OF HDRS

Usability evaluation is an attempt to measure the user's perception of a recommender system after an interaction experience. The essence of usability testing is to assess the quality of human-computer interaction properties of a system. According to ISO 924-11 (1998), usability is the extent to which specified users can use a system to achieve specified goals with effectiveness, efficiency and satisfaction. It is also, a perception of a system's ease of learning and use from both the experienced and un-experienced users' viewpoint (Lindgaard, 1994).

Our adoption of prototype usability testing was not only to evaluate the HDRS but to also obtain timely feedbacks from potential users prior to committing further investments of resources to its development. Since we fully consent to the fact that the use of empirical testing with potential users is still the best way to find problems related to user's task and experiences (Riihiaho, 2000; Zins et al., 2004).

Herlocker et al. (2004) suggested the use of explicit (ask) and implicit (observe) feedbacks as the most appropriate for user evaluation of RS, and emphasised the need to clearly define the task that a recommender system is intended to support before its evaluation. Therefore, standard usability testing concepts (Nielsen, 1993) was used for evaluating our HDRS.

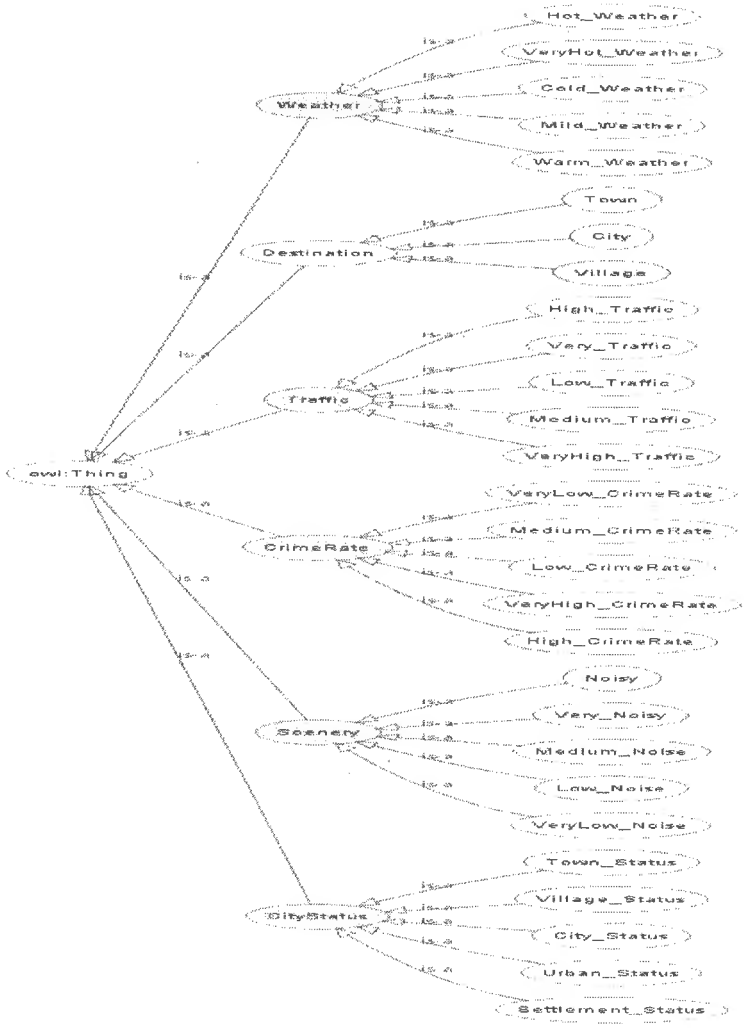


Figure 3. A Visualization of Class Entities of the Nigerian City Ontology in Protégé 3.3.1

Figure 4. A Snapshot of the HDRS Prototype

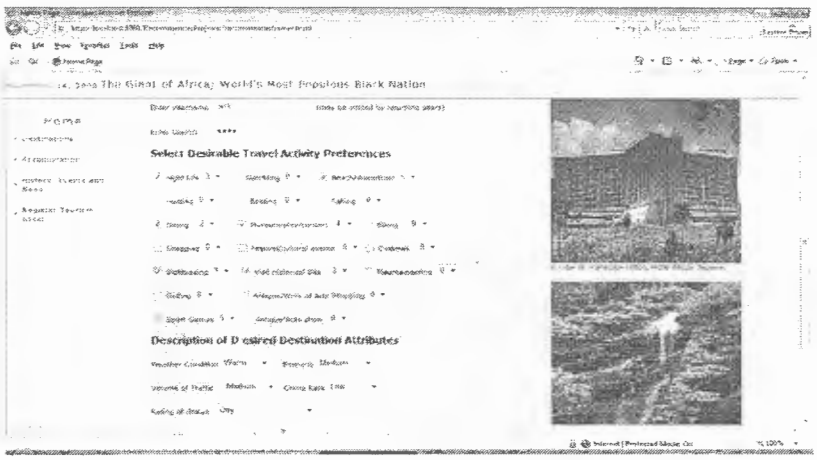
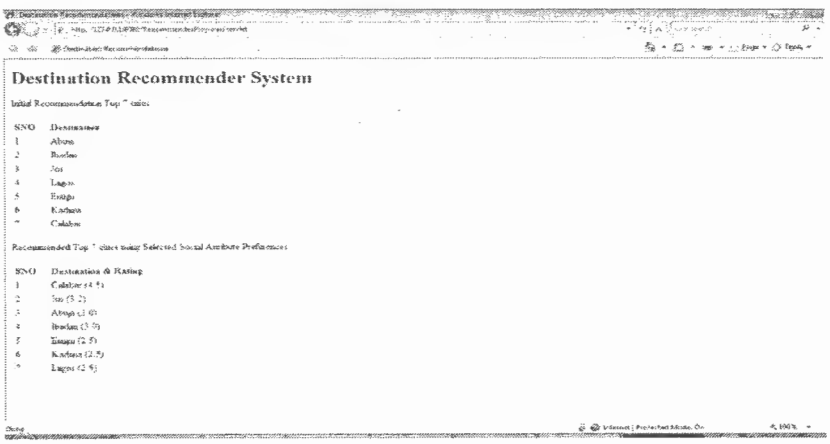


Figure 5. A Snapshot of Recommendation Results from HDRS



Experiment Design

A trial experiment was undertaken with 20 users, including 5 non-Africans who have been resident in Nigeria for an upward of three years, 5 Africans on short visit to Nigeria for the purpose of religious tourism. The rest of the sample user population were drawn from the business-traveller group that consist of contractors, business men and professional executives. All the participants gave their informed consent to participate in the experiment, and were taken through a 15 minutes tutorial session at the commencement of the experiment. Participants were requested to respond to a pre-experiment questionnaire which was specifically designed to evaluate the background of the participants particularly in terms of their IT skills, knowledge of the Internet, familiarity with recommender systems, e-commerce portals, and general tourism and travel experience. They were asked to rate themselves on a scale of 100, which was graduated into 5 class categories. The specified task for the HDRS is to provide intelligent recommendation to the user on the most probable Nigerian locations to spend the next vacation after it has been supplied with a list of travel activity preferences and social attributes description of a desirable destination. The system was configured to operate in two modes and participants were allowed to engage the system in as many sessions as they chose in each mode. In the first mode, the social attributes aspect of the system was disabled such that the system offered recommendation without allowing users to specify social attribute preferences, while in the second mode the opportunity to specify social attribute preferences was provided.

The post-experiment questionnaire was a customisation of the Post-Study-Satisfaction-User-Questionnaire (PSSUQ) standard (Lewis, 1995; Zins et al., 2004). The PSSUQ had 26 questions, which were specifically adapted for a destination recommender system context (See Table 1). Items 16 and 17 in the questionnaire were specifically designed to capture users' impression of the system's recommendations when social attributes information is used and when not used, which is to be analysed to determine the potential influence of the inclusion of social attributes information of destinations on the dependability of recommendations. The participants were required to rate each item in the post-experiment question on a scale of 1-5 (1-Excellent, 2-Good, 3-Satisfactory, 2-Unsatisfactory, 1-Poor) while 'n/a' should be used for any questionnaire item they choose not to rate.

Table 1. Usability and User Satisfaction Questionnaire

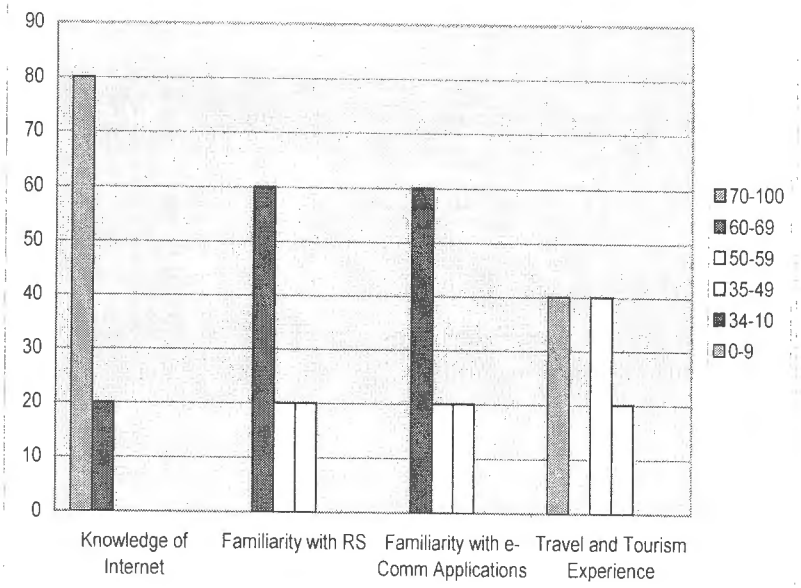
	Items	5	4	3	2	1	n/a
	Design/Layout						
1	I liked using the interface of the system.						
2	The organization of information presented by the system was clear.						
3	The interface of this system was pleasant to use.						
	Functionality						
4	This system has all the functions and capabilities that I expect it to have to perform its task						
5	The options listed by the system as a reply to my request were suitable for my travel.						
6	I agree with the suggested recommendation of the system and believe it will be useful						
7	**Ease of Use**						
8	It was simple to use this system.						
9	It was easy to find the information I needed.						
10	The information (such as online-help, on-screen messages, and other documentation) provided with this system was clear.						
11	Overall, this system was easy to use.						
	Learnability						
12	It was easy to learn to use the system.						
13	There was too much information to read before I can use the system.						
14	The information provided by the system was easy to understand.						
	Satisfaction						
15	I felt comfortable using this system.						
16	I am satisfied with recommendations when social attributes information of destination is used. (*)						
17	I am satisfied with recommendations						

	when social attributes information of destination is not used. (*)						
18	Overall, I am satisfied with this system.						
	Outcome / Future Use						
19	I was able to complete the task quickly using this system.						
20	I could not complete the task in the preset time frame.						
21	I believe I could become productive quickly using this system.						
22	The system was able to convince me that the recommendations are of value.						
23	From my current experience with using the system, I think I would use it regularly.						
	Errors / System Reliability						
24	Whenever I made a mistake using the system, I could recover easily and quickly.						
25	The system gave error messages that clearly told me how to fix problems.						
26	In my opinion the system is somewhat fault tolerant						

Results and Analysis

We did the analysis of the pre-experiment and post-experiment questionnaires. It was discovered that 80% of participants claimed to be expert Internet users (indicating a rating of 70-100). 60% of participants' also claimed to have very good familiarity with RS and e-commerce applications, while 40% rated their travel and tourism experience as excellent while another 40% rated their travel and tourism experience within Nigeria as above average. The remaining 20% claimed to have little or no travel and tourism experience. Figure 6 is a chart showing a summary of the background of participants according to their familiarity with e-commerce applications, RS and previous tourism experience.

Figure 6. Summary of Background of Participants



Post –Experiment Results

The feedbacks obtained from users through the post-experiment questionnaire was analysed statistically to determine the mean scores of user ratings of the system based on the seven usability metric parameters used to evaluate the system. Table 2 shows the mean scores of the parameters used. These are: design/layout, functionality, ease of use, learnability, satisfaction (which was split into two, i.e. when social attributes information is used and when social attributes information is not used), future use (confidence), and reliability. From the result, our HDRS had a mean score of above 4 in seven out of the 8 parameters used which suggest an acceptable level of performance. From our experiment, it was discovered that most users expressed satisfaction; and showed preference for recommendations that were based on the use of social attributes information over when social attributes information was not used.

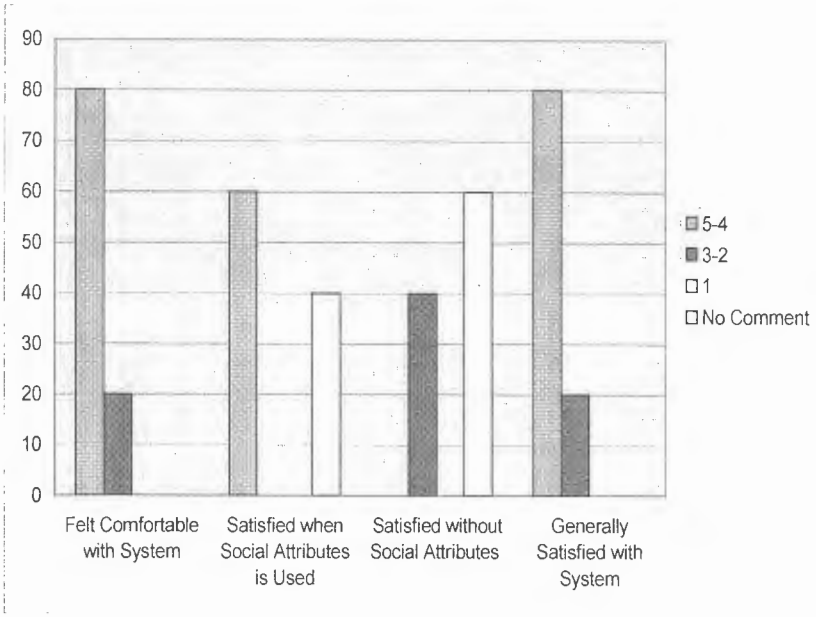
Table 2. Means Scores of Usability Metrics for HDRS

	Usability Metrics	Mean Scores	Std. Deviation
1	Design/Layout	4.13	0.57
2	Functionality	4.19	0.63
3	Ease of Use	4.15	0.25
4	Learnability	4.00	0.76
5	Satisfaction/Social attributes	4.15	0.78
6	Satisfaction/without Social attributes	3.58	1.05
7	Outcome/Future Use	4.20	0.34
8	Reliability	4.02	0.68

Also, from our experiment, 80% of the sample population responded that they felt comfortable with the system by giving it a rating of 5(excellent) or 4(good). 20% of the participants gave the system a rating of 3(satisfactory) or 2(unsatisfactory). 60% of the sample population rated the recommendations of the system as excellent or good when social attributes information was used, 20% of participants rated the recommendations as satisfactory or unsatisfactory, while 40% chose not to comment. Also, 20% of participants rated recommendations of the system as 3(satisfactory) or 2(unsatisfactory) when social attributes information was not used, 0% rated it as excellent or good, while 40% chose not to comment. 80% of participants felt generally satisfied with the system. Figure 7 is a visualization of user's satisfaction with the recommendation of the HDRS prototype.

The results of the evaluation experiment clearly supports the notion that making use of social attributes information as a factor in destination recommendation can indeed boost the dependability of destination recommendations.

Figure 7. Summary of User's Satisfaction with the Recommendations of the HDRS



CONCLUSION

In this work, we have implemented an ontology-based Hybrid Destination Recommender System (HDRS). We have also introduced the ontological filtering of the social attributes information as a factor in the destination recommendation in contrast to what currently exist in most destination recommendation portals. Our empirical evaluation of users' perception of recommendations from the HDRS was considered satisfactory. It was also revealed that the use of social attributes information for destination recommendations has the potential to improve the dependability of such recommendations, and thus giving credence to the novelty of our approach.

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