

on a family trip previously, the preferences will be checked in general regardless of the trip type.

9. Conclusions and Future Work

Recommender systems are used to filter services and bring forward the most suitable ones for users from a huge amount of information on the internet. Hybrid recommender systems can improve the recommendations provided since they use more than one approach. The multi-dimensional approach of recommender systems allows considering more dimensions in the process of providing more suitable recommendations to users. Contextual information has been proven to be helpful to be considered when providing recommendations based on user's context. Integrating a multi-dimensional recommender system with a multi-agent system will lead to an enhancement of the pro-activity of recommender system especially for the tourism domain. The system proposed in this paper was designed and implemented to bring recommendations for tourists pro-actively and organize them as a trip schedule. The contextual information used are the type of the trip, time, the current location and preferences of the user. The system shows promising results when tested based on various scenarios. Results show the variety of responses of the system in different contexts with/without users' profiles explicitly inferred.

As for future work, we intend to enhance the quality and quantity of services provided to travelers. More contextual information can be considered such as the weather. The pro-active travel assistant should then be able to provide a wider range of services to the user. This can be achieved by using more service provider websites than the one used here. Also, there is a need to automate and update the restaurants table from the state it is in currently. Moreover, the pro-activity and the intelligence of the system will be further enhanced to cover the emergency cases that a traveler might face abroad. Lastly, the evaluation can be enhanced further by applying the methodology of information retrieval experiments [15].

10. References

- [1] G. Picco, "Mobile Agents: An Introduction, Microprocessors and Microsystems", Springer, 2001, 25(2): 65-74.
- [2] C. G. Harrison, D. M. Chess, and A. Kershenbaum, "Mobile Agents: Are they a good idea?", Technical Report, IBM Research Division, T. J. Watson Research Center, 1995.
- [3] A. Felfernig, S. Gordea, D. Jannach, E. Teppan, M. Zanker, "A short Survey of Recommendation Technologies in Travel and Tourism", OEGAI Journal 25 (7), Oesterreichische Gesellschaft fuer Artificial Intelligence, 2007, pp. 17-22.
- [4] M. Wooldridge, N. Jennings, "Intelligent Agents: Theory and Practice", The Knowledge Engineering Review, vol. 10, 1995, pp.115-152.
- [5] Y. Wei, L. Moreau, and N. Jennings, "Recommender systems: A market-based design", Proc. Second International Joint Conference on Autonomous Agents and Multi Agent Systems (AAMAS03), Melbourne, Australia, 2003, pp. 600-607.
- [6] B. Schilit, N. Adams, and R. Want. "Context-aware computing applications". IEEE Workshop on Mobile Computing Systems and Applications (WMCSA'94), Santa Cruz, CA, US:89-101, 1994.
- [7] K. Anind Dey, "Understanding and Using Context". Personal Ubiquitous Computing 5(1): 4-7.2001.
- [8] M.N. Huhns, D. Bridgeland, "Multiagent truth maintenance", IEEE Transactions on Systems, Man, and Cybernetics, 1991, 21(6):1437-1445.
- [9] F. Lorenzi, A.L.C. Bazzan, M. Abel, "An Architecture for a Multiagent Recommender System in Travel Recommendation Scenarios", ECAI workshop on Recommender Systems, August 2006, Riva del Garda, Italy, pp. 88-91.
- [10] A.Casali, A. Von Furth, L. Godo, C. Sierra, "A Tourism Recommender Agent: Form theory to practice", WASI-CACIC 2007, Corrientes, Argentina, 2007, pp 1548-1561.
- [11] G. Adomavicius, R. Sankaranarayanan, S. Sen, and A. Tuzhilin, 2005. Incorporating contextual information in recommender systems using a multidimensional approach. JTOIS, 23(1), 103-145.
- [12] A. Goy, L. Ardissono, and G. Petrone, "Personalization in e-commerce applications". In The Adaptive Web, Springer, Berlin/Heidelberg, 2007, pp. 485-520.
- [13] Z. Wa, "Personalized Tourism Information System in Mobile Commerce", Proc. IEEE International Conference on Management of e-Commerce and e-Government, Washington DC, 2009, pp. 387-391.
- [14] N. Tintarev, J. Masthoff: A survey of explanations in recommender systems. In: ICDE Workshop on Recommender Systems & Intelligent User Interface, 2007.
- [15] S.E. Robertson, The methodology of information retrieval experiment. In: K. Sparck Jones (ed.), *Information retrieval experiment*. Butterworths, 1981. (pp 9-31).