Social mechanisms for content quality control in web-based learning: An agent approach

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Abstract

This paper investigates interaction of users with multiple agents in the context of web-based implicit communities of learners. In particular a user-centred quality-of-content control mechanism is presented, inspired by social protocols of interaction, which is used for building and maintaining cohesion of such communities. This takes the form of an innovative algorithm for ranking offers of educational material from heterogeneous educational sites, modelled as autonomous information agents. This algorithm takes into consideration the social acceptability of each sites' contents. The described user interaction with this multi-agent system allows for adaptive participation in the educational process, while maintaining the user as the principal locus of control in the user-system interaction.

1 Introduction

The web has been considered, since its early days, a medium suitable for learning. However the role of the student in most current web-based educational systems is that of a passive receiver of educational content. This is despite the fact that modern pedagogical views suggest active participation of the student in the learning process. In addition, learning is considered a social process (Bruckman, 2002, Dillenbourg, 1996). So collaborative learning has gained prime importance in most realms of contemporary learning sciences. Since the web has recently started playing the role of effective enabling technology for collaboration and community building besides that of the more traditional information gathering (Bruckman, 2002, Preece 2000), the use of the web as means for building communities of active learners is very interesting perspective.

In this context, one can distinguish two types of learners' communities: Those that necessitate explicit membership and the ones in which participation is implicit, e.g. collaboration emerges as the result of sharing peer members' views on the common resources. The latter case, i.e. that of implicit learners communities, is particularly interesting and is the subject of research reported in this paper.

In particular, we refer to the design of a prototype to facilitate online and web-based study. The main problem in this context is to provide easy and flexible access to various data residing in multiple, unstructured, heterogeneous information resources, and to integrate these data into semantically coherent information. An objective is also to support social cohesion through meta-information sharing about the educational resources. The proposed solution is the introduction of autonomous, goal-driven agents that permit collaboration and facilitate access to heterogeneous educational resources through an open-system approach. The users of this environment can direct their attention to various complementary sources of educational material. An important

mechanism developed in the frame of this architecture is the quality control of the content by the users themselves, thus creating a social network of individual and community-wide preferences. This is the main mechanism used for maintaining the implicit community of the users of these shared resources.

In this paper we present and discuss the design of this multi-agent distance learning system. Issues of control, transparency, heterogeneity and protection of user privacy are discussed in relation to existing system architectures. Subsequently special focus is given to the user interaction with this distance-learning platform. It is argued that the proposed approach can tackle effectively some of the key issues of user interaction with multi-agent systems and community support and is relevant to other application areas with similar characteristics.

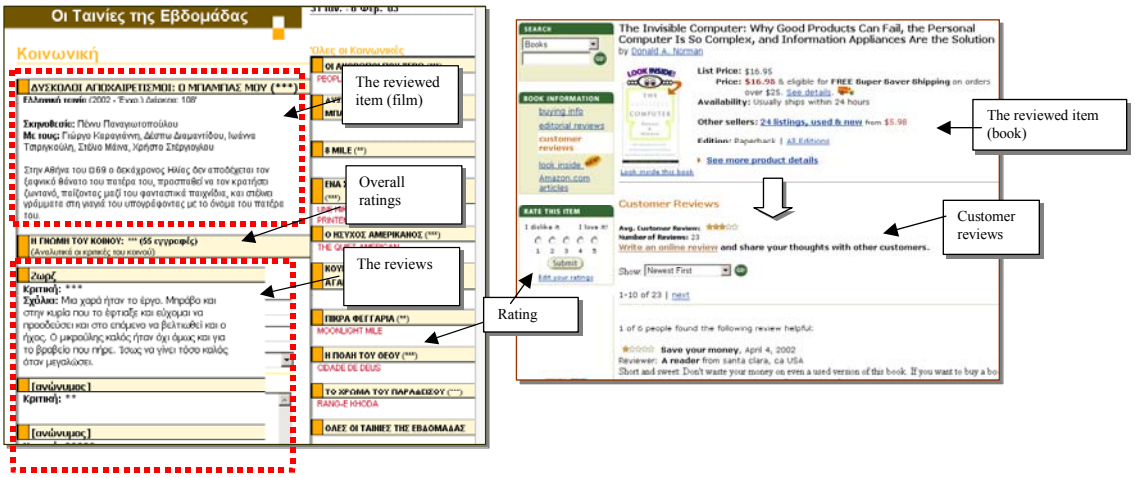

Figure 1. Implicit community of cinemagoers in the area of Athens, Greece (www.athinorama.gr) and of the amazon bookshop customers (www.amazon.com).

2 On implicit communities

Web-based implicit communities are formed by users who share resources and maintain meta-information relating to them without getting engaged in direct interaction. Examples of such communities are often found in the web. Two typical examples are discussed in this section. The first example is the community of performing-arts spectators of the Athens region in Greece. This community is built around the website *www.athinorama.gr*, which provides information on cultural events in the Greek capital. The designers of the site, owners of a popular weekly on city life, allow for the public to provide their views on films and theatre plays watched. Long chains of viewers' comments are included in the site. See figure 1(a). A rating on a 1 to 5 star scale is provided as a subjective quantitative measure of the expressed views. The most active reviewers provide usually a nickname, many remain anonymous, while some reviewers provide just a rating with no additional comments. It is common for writers of comments to read earlier reviews and refer to them, however no threading of this exchange of views is allowed, since the same person cannot provide a second opinion on the same item. The site provides an overall rating of the reviewed item as a mean value of the reviews' ratings. In the screenshot of figure 1(a), the film has been reviewed by 55 users and has received a 3 out of 5 rating. The reviews are presented in

inverse chronological order, the most recent on top. While items with associated average ratings are shown on the screen, no ranking of items is provided according to spectators' views. Users of the website may identify frequent reviewers who provide comments on many of the films and plays that are on show. So a real community of people who share interests and exchange views, without getting engaged in direct communication is formed through this website.
A second example of implicit community is that maintained by the popular online bookshop amazon (*www.amazon.com*), see fig. 1(b). The items to be reviewed in this case are books, sold by the bookshop. The comments are relatively longer and the reviewers can come from any geographical location in the world. Fewer people provide anonymous reviews in this case. The overall rating of a book, is provided by the site, as in the previous case. It should be noticed that in this case the website provides this reviewing facility not as its main mechanism for influencing prospective buyers, since there are additional ways for making suggestions on books, e.g. thematic grouping, books bought by other shoppers, comments by publishers, authors etc. However in this case the customer reviews facility is supporting building of an implicit community, even if this might not have been the prime objective of the website builders.
In these two discussed examples the website makes reference to items that are locally stored in the database, there is an invested interest in the relationship between the web site visitors and the website owner, while the items rating is performed in both cases in addition to verbal comments. The discussed implicit communities have many differences from usual on-line communities, the most notable of which is the lack of direct communication of the community members. In the following we discuss a new framework for web-based learning in an open environment that uses some of the presented ideas of implicit communities.

3 The learners community-building architecture

The proposed architecture (Solomos & Avouris 1999, Avouris & Solomos 2001) contains an open number of educational systems that can register and withdraw from the society temporarily or permanently without affecting other agents' tasks. Each educational source can interact with other peer sources through an agent who acts as representative of the educational source. The content can be an electronic multimedia book, an intelligent tutoring system or any other web-based educational system. The agent contains a meta-level description of the content, according to a commonly used educational ontology, hierarchically structured in a four-level model. A specifically designed communication language has been defined (EACL, see Solomos & Avouris 1999), supporting agent interaction, based on the widely used KQML language performatives (Finin, Labrou, Mayfield, 1997), implementing an adaptation of the contract net collaboration protocol for the educational domain.
The typical scenario of user interaction with this environment, involves the following steps:
(a) The user searches the available resources and sends a request (r) through the user agent, see figure 3 (a).
(b) The user agent seeks suitable agents to satisfy the request (r) through the server. The server searches the meta-description of registered agents and selects the most suitable ones to which it forwards the request (r)
(c) The agents send their bids to the user. The bids are ranked according to their content and previous history of interaction with the bidding agents (social acceptability factors) and are presented to the user, see figure 3(b).
(d) The user selects one of the offers and the corresponding agent is requested to provide the content through a new interaction window, figure 3(c).

(e) After completion of interaction with the selected source, the user is asked to evaluate the provided content, see figure 3(d). Only quantitative measures are requested, in contrary to other implicit communities, discussed earlier. This evaluation is stored in the relevant databases in order to influence future user-agents interaction.

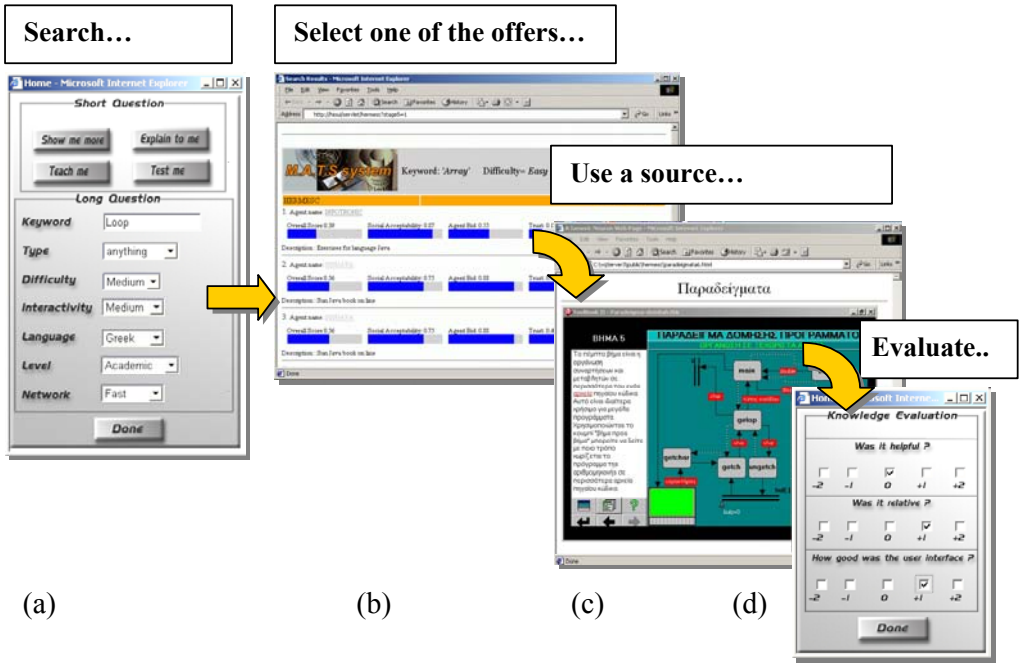

Figure 2. The four step interaction with the learners' community environment.

This peer user evaluation is stored both locally in the User Database and in the Server, where a record of users' evaluation of provided services is stored in the Social Acceptability Database. These evaluations are used for ranking the offers presented in future users. The ranking of offers is important, as with web search engines. The ranking criteria used are based on an adapted version of the contract net protocol modified by a social acceptability factor. In the traditional contract net protocol (Smith, 1988, Sandholm & Lesser, 1998) the offers of the bidders relate the bid request to their capabilities, and performance characteristics. In the proposed architecture the bids express the capability of the bidder to satisfy the requirements of the requesting agent, the relevance of their content, the similarity in educational level, the style of presentation etc, called the bid factor (BF). In the proposed architecture however the bid-ranking algorithm is not based on just the offering agents' bids. BF is considered a subjective evaluation factor, since all bidders do not use similar standards for describing the quality and the characteristics of their content. A more objective criterion is to adjust the offers by a measure of credibility of the offering bidders. This is based on two factors: the previous history of the particular user interaction with the offering agent (the *Trusted Agents Factor, TAF*) and the social consensus on the quality of the agent (the *Social Acceptability Factor, SAF*). TAF is stored in the local user database, while SAF is provided by the server database. These factors model a social network of evaluation of services by the human agents built within the agents' society.

Agent Ranking (AR) is thus estimated according to the following formula:

$$AR(EA_i) = (w_1 * TAF_i + w_2 * SAFi + w_3 * BF_i)/S\, w_j$$

Where: w1 and w2 are weighting factors calculated as functions of N, i.e. the number of

evaluators that participated in the estimation of the corresponding factors, according to the following formulas:

$$w_1 = (N1/NTmax)*w_T \quad and \quad w_2 = (N2/NSmax)*w_S$$

N1 and N2 are the number of evaluations that are contained in the corresponding databases, NTmax , NSmax the maximum number of recent evaluations that can be taken in consideration and w_T , w_S are constant weight factors. In case that N>= Nmax, then the Nmax more recent evaluations are taken into account. In our example the weights used are $w_T=w_S=0.3$ and $w_3=0.4$.

4 Conclusions

The architecture of an open system that can integrate heterogeneous educational resources has been presented in this paper. An essential part of the architecture is the algorithm for ranking offers of material through the search engine of the user. This algorithm takes into account the evaluation of the peer users of the available resources. This way the human society's rules that establish evolution of trust and commitment, based on the history of social interaction are modelled. According to these rules, the selection of a service provider is based on a combination of previous positive experience with the candidate and other people's positive experiences. An implicit community of peer learners is build through this mechanism. In contrary to other communities, in this case, the views of peers influence the search engine and is interweaved in the system. During the evaluation of the described prototype, the users did not object to the imposed short evaluation questionnaire, since it was task-related and it provided them with the opportunity to express their view on the service. However longer experimentation with wider communities of users of this architecture are needed in order to confirm the first positive findings.

Acknowledgements

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5 References

Avouris N., Solomos K., (2001), User Interaction with Web-based Agents for Distance Learning, J. of Research and Practice in Information Technology, 33 (1), pp. 16-29, February

Bruckman A. (2002), The future of e-learning communities, Communications of the ACM, 45 (5), pp. 60-63.

Dillenbourg, P., Some technical implications of distributed cognition on the design of interactive learning environments, J. of Artificial Intelligence in Education, 7 (2), pp. 161-180, 1996.

Finin T., Labrou Y., Mayfield J., (1997). KQML as an Agent-Communication Language, Chapter 14 in Bradshaw J.M. (ed.) Software Agents, pp. 291-316, AAAI Press.

Preece J. (2000), Online Communities, Designing Usability, Supporting Sociability. J. Wiley, Chichester, UK.

Sandholm T., Lesser, V. (1998), Issues in Automated Negotiation and Electonic Commerce: Extending the Contract Net Framework, in Huhns M.N., Singh M.P. (eds.) Readings in Agents, pp. 66-73, Morgan Kaufmann, San Fransisco.

Smith R.G (1988). The contract net protocol: High-level communication and distributed problem solving. In Readings in Distributed Artificial Intelligence, Morgan Kauffman.

Solomos K., Avouris N. (1999), Learning From Multiple Collaborating Intelligent Tutors: An Agent-Based Approach, J. of Interactive Learning Research, 10 : 3/4, pp. 243-262.