Sharing online cultural experiences: An argument-based approach

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Abstract. This paper proposes a system that allows a group of human users to share their cultural experiences online, like buying together a gift from a museum or browsing simultaneously the collection of this museum. We show that such application involves two multiple criteria decision problems for choosing between different alternatives (e.g. possible gifts): one at the level of each user, and one at the level of the group for making joint decisions. The former is made manually by the users via the WeShare interface. This interface displays an image with tags reflecting some features (criteria) of the image. Each user expresses then his opinion by rating the image and each tag. A user may change his choices in light of a report provided by his WeShare agent on the opinion of the group. Joint decisions are made in an automatic way. We provide a negotiation protocol which shows how they are reached. Both types of decisions are based on the notion of argument which has a particular form. Indeed, a tag which is liked by a user constitutes an argument pro the corresponding image whereas a tag which is disliked gives birth to a cons argument. These arguments may have different strengths since a user may express to what extent he likes/dislikes a given tag. Finally, the opinion analysis performed by a WeShare agent consists of aggregating the arguments of the users.

1. Introduction

Cultural institutions such as museums have been placed under financial pressure by the European economic crisis. Consequently, several museums in the UK, for instance, reduced their opening hours [13,15]. Internet may partly solve this problem since some digital versions of several institutional collections are available online. This is represented as a searchable database containing many images of objects held by an institution. Besides, internet has completely changed the every day life of people and their ways of acquiring information. Indeed, most people would prefer visiting online a museum than going physically. However, actual systems are not able to respond to complex requests made by a group of users. They do not provide a realtime social experience, where each user is aware of the other people online and can interact with them. Finally, they do not offer the possibility of browsing in a synchronous way the same objects.

In this paper, we propose a system that provides the previous functionalities. It allows two or more users to connect to the digital collection of a museum, browse synchronously images, and decide all together which image to add to their joint collection or which one to buy. Such an application involves two multiple criteria decision problems: one at the level of each user for accepting/rejecting a displayed image, and one at the level of the group for making a joint decision about the same image. The former is made manually by the users via the *WeShare* interface. This interface displays an image with *tags* sent by the server of the museum. A tag represents a feature (or a criterion) of an image. Each user expresses then his opinion by rating the image itself and each tag. In addition, he provides various weights expressing to what extent he likes/dislikes the image and the tags. Joint decisions are made in an automatic way. We provide a negotiation protocol which shows how they are reached. Both types of decisions are based on the notion of *argument* which has a particular form in this system. Indeed, unlike existing logical argumentation systems where an argument is a logical proof for a given conclusion (e.g. [2,7,19]), an argument in favor of an image is a pair ((tag, value), image). When a user likes the tag (i.e. the value is positive), then the argument is pro the image. However, when the tag is disliked, the pair is a cons argument. These arguments with varying strengths are thus built by the users through the WeShare interface. Again, unlike argumentation systems for defeasible reasoning where the construction of arguments is monotonic, in our application this is not the case. Actually, a user may revise his opinion about a given tag. Consequently, the initial argument is removed and replaced by the new one. This revision is possible in light of a report provided by the user's WeShare agent on the opinion of the group. Indeed, an analysis of the opinion of the group is performed. It consists of aggregating the arguments of the users. We propose two aggregation operators: one that computes the average value for each tag and the average value of the image. The second operator aggregates in the same way the values of the tags, however applies a multiple criteria procedure for computing the final recommendation of the image.

The paper is organized as follows: Section 2 provides the architecture of our system. Section 3 describes the decision procedure of the server, namely how it selects the next image to browse. Section 4 describes the activities of the human user as well as his assistant agent. Section 5 provides a negotiation protocol that allows the group of users to make a common decision about a given image. The last section concludes.

2. System Architecture

The architecture of our system is depicted in Figure 1. It contains two main components: a *Media Server* agent and a *WeShare* agent per human user.

The Media Server agent has access to the database of the museum. It is equipped with a decision model that computes the next image to propose to the users. That image is sent to the WeShare agents which display the image to all the users at the same time. In addition to the image, the Media Server agent provide several tags associated with an image. They represent some particular features of the image, like being *fish* in the image shown in Figure 2.

WeShare agents consists of two different subcomponents: the User Assistant agent and the Deliberating agent. The User Assistant agent forms a layer between the WeShare interface (GUI) and the system. Through the interface (Figure 2), users express whether they like or not the image. Similarly, they can evaluate positively or negatively each tag. For instance, in the case of Figure 2, one may say that he likes the image, the fact that it represents a fish, but does not like that it is a toy.

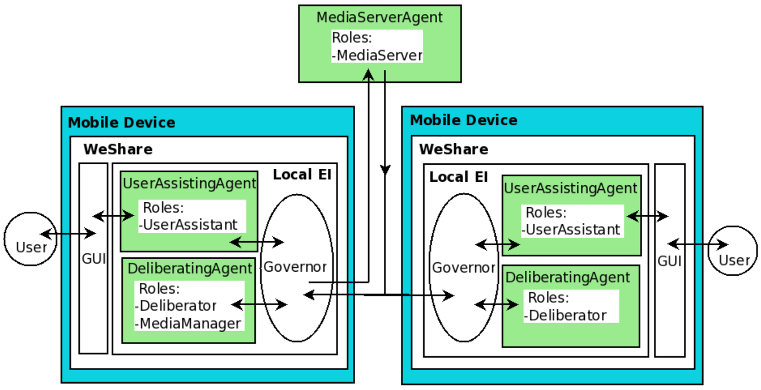

Figure 1. The agents and the roles they play. Arrows indicate exchange of messages.

The Deliberating agent is responsible for collecting liked and disliked tags of users in terms of preferences and rejections. It also maintains the preferences and rejections of other agents. It has a decision model for opinion analysis. Moreover, it is equipped with a negotiation protocol which allows the users to decide whether to accept or not a given displayed image.

The communication between the agents in the system is regulated by a lightweight version of a peer-to-peer Electronic Institution (Local EI). Generally speaking, Electronic Institutions allow to model and control agents' interactions. Since they are out of scope of this paper, we omit their description and we refer to [5,10].

The decision models of the Media Server and WeShare agents will be described in the following sections.

3. Media Server Agent

The Media Server agent is responsible for answering the queries made by human users. This agent is equipped with an *image archive* which consists of 2500 image files. Throughout the paper, $\mathcal{I} = \{im_1, \ldots, im_n\}$ (with $n = 2500$) is the set of available images where each $im_i \in \mathcal{I}$ is the identifier of an image. Each image is described with a finite set of *tags* or *features*, for instance the color. The set $\mathcal{T} = \{t_1, \ldots, t_k\}$ contains all the available tags. Finally, we assume the availability of a function $\mathcal{F} : \mathcal{I} \to 2^{\mathcal{T}}$ that returns the tags associated with a given image. Note that the same tag may be associated with more than one image.

The Media Server agent is also equipped with a decision model which defines a preference relation $\succeq$ on a set $\mathcal{I}' \subseteq \mathcal{I}$. The best element with respect to this relation is sent to the WeShare agents for browsing. In case of ties, one of them is chosen randomly. An important question now is how is the relation $\succeq$ defined? The model has three inputs:

1. A set $\mathcal{I}' \subseteq \mathcal{I}$ of images.
2. A set of preferences $\mathcal{P} \subseteq T$ of tags that an image should have,
3. A set of rejections $\mathcal{R} \subseteq T$ of tags that an image should not have.

The two sets $\mathcal{P}$ and $\mathcal{R}$ represent respectively the preferences and the rejections of the group of users. They are provided by the Deliberating agent of a user, the one who

Figure 2. WeShare interface.

is the administrator of a browsing session, as we will see in Section 5. The decision model prefers the image that suits better these preferences and avoids the rejections. This principle is suitable when all the tags are equally important. It is worth pointing out that several principles can be found in [4,9,11] in case of weighted tags.

Definition 1 (Decision model) *Let* $\langle \mathcal{P}, \mathcal{R}, \mathcal{I}' \rangle$ *be the input sets. For* $im_i, im_j \in \mathcal{I}'$, $im_i \succeq im_j$ *iff* $|\mathcal{F}(im_i) \cap \mathcal{P}| \geq |\mathcal{F}(im_j) \cap \mathcal{P}|$ *and* $|\mathcal{F}(im_i) \cap \mathcal{R}| \leq |\mathcal{F}(im_j) \cap \mathcal{R}|$.

It is easy to check that the relation $\succeq$ is a partial preorder. Its maximal elements are gathered in the set $\max_{\succeq}$ defined as follows: $\max_{\succeq} = \{im_i \in \mathcal{I}'$ s.t. $\nexists im_j \in \mathcal{I}'$ with $im_j \succeq im_i\}$. Note also that in case the two sets $\mathcal{P}$ and $\mathcal{R}$ are empty, all the images are equally preferred. Finally, the Media Server sends to the WeShare agents one of the best images wrt. the relation $\succeq$. In case the set $\max_{\succeq}$ is empty, an image is chosen randomly.

Definition 2 (Best image) $\texttt{Best}(\langle \mathcal{P}, \mathcal{R}, \mathcal{I}' \rangle) = \begin{cases} im_i \in \max_{\succeq} & \textit{if } \max_{\succeq} \neq \emptyset \\ im_i \in \mathcal{I}' & \textit{else} \end{cases}$

To simplify notation we will use $\texttt{Best}(\mathcal{I}')$ in the rest of the paper.

4. Human User and WeShare Agent

Human users interact with the system via the WeShare interface depicted in Figure 2. Each user is responsible for expressing an opinion about each image sent by the Media Server agent. Indeed, he provides an overall rating to the image as well as a (positive or negative) value to each tag associated with the image. Throughout the paper, we assume the availability of a bipolar scale $\mathcal{S} = [-1, 1]$ which is used for evaluating the tags and the image. Assigning a positive value to an image means that the image is recommended. For a given image $im \in \mathcal{I}$, each user u_i provides the following information:

User/Tags	t_1	$\dots$	t_j	$\dots$	t_m	im
u_i	$v_{i,1}$	$\dots$	$v_{i,j}$	$\dots$	$v_{i,m}$	r_i

where $\mathcal{F}(im) = \{t_1, \dots, t_m\}$, $v_{i,j} \in \mathcal{S}$ is the value assigned by user i to tag j, and $r_i \in \mathcal{S}$ is the overall rating of the image im.

A user can revise his opinion in light of a report sent by his WeShare agent about the opinion of the remaining users. Note that the WeShare agent only gives advices to the user and the final decisions are made by the user himself. Finally, a user may engage in a negotiation dialogue with other users in order to persuade them to accept/reject a given image. This part will be described in Section 5.

4.1. Arguments

The notion of argument is at the heart of several models developed for reasoning about defeasible information (e.g. [12,17]), decision making (e.g. [4,8]), practical reasoning (e.g. [6]), and modeling different types of dialogues (e.g. [3,18]). An argument is a reason for believing a statement, choosing an option, or doing an action. In most existing works on argumentation, an argument is either considered as an abstract entity whose origin and structure are not defined, or it is a logical proof for a statement where the proof is built from a knowledge base. In our application, arguments are reasons for accepting or rejecting a given image. They are built by the human user when rating the different tags associated with an image. Indeed, a tag which is evaluated positively gives birth to an argument pro the image whereas a tag which is rated negatively induces a con argument against the image. The tuple $\langle \mathcal{I}, \mathcal{T}, \mathcal{S} \rangle$ will be called a *theory*.

Definition 3 (Argument) *Let $\langle \mathcal{I}, \mathcal{T}, \mathcal{S} \rangle$ be a theory and $im \in \mathcal{I}$.*

- *An* argument pro *im is a pair $((t, v), im)$ where $t \in \mathcal{T}$ and $v \in \mathcal{S}$ and $v > 0$.*
- *An* argument con *im is a pair $((t, v), im)$ where $t \in \mathcal{T}$ and $v \in \mathcal{S}$ and $v < 0$.*

The pair (t, v) is the support *of the argument and im is its* conclusion*. The functions* `Tag`*,* `Val` *and* `Conc` *return respectively the tag t of an argument $((t, v), im)$, its value v, and the conclusion im.*

It is well-known that the construction of arguments in systems for defeasible reasoning is monotonic (see [2] for a formal result). Indeed, an argument cannot be removed when the knowledge base from which the arguments are built is extended by new information. This is not the case in our application. When a user revises his opinion about a given tag, the initial argument is removed and replaced by a new one. For instance, if a user assigns value 0.5 to a tag t which is associated with an image im, then he decreases the value to 0.3, the argument $((t, 0.5), im)$ is no longer considered as an argument and is completely removed from the set of arguments of the user and is replaced by the argument $((t, 0.3), im)$. To say it differently, the set of arguments of a user contains only one argument per tag for a given image.

4.2. Opinion analysis

Opinion analysis is gaining increasing interest in linguistics (see e.g. [1,14]) and more recently in AI (e.g. [16,20]). This is due to the importance of having efficient tools that provide a synthetic view on a given subject. For instance, politicians may find it useful to analyze the popularity of new proposals or the overall public reaction to certain events. Companies are definitely interested in consumer attitudes towards a product and the reasons and motivations of these attitudes. In our application, it may be important for each user to know the opinion of the group about a certain image. This may lead the user to revise his own opinion.

The problem of opinion analysis consists of aggregating the opinions of several agents/users about a particular subject, called *target*. An opinion is a global rating that is assigned to the target, and the evaluation of some features associated with the target. Thus, this amounts to aggregating arguments which have the structure given in Definition 3. Let us illustrate this issue on the following example.

Example 1 *Let us consider the following opinion expressed on a digital camera.*

> *"It is a great digital camera for this century. The rotatable lens is great. It has fast response from the shutter. The LCD has increased from 1.5 to 1.8, which gives bigger view. But, it would be better if the model is designed for smaller size. I recommend this camera."*

The target here is the digital camera, the overall rating is "recommended". The features are: the size, rotatable lens, response from the shutter, size of LCD. For instance, response from the shutter is evaluated positively whereas the size is evaluated negatively.

In our application, the target is an image sent by the Media Server agent and the features are the associated tags. In what follows, we propose two models that are used by the WeShare agents of the users (in particular by the Deliberating agent component) in order to analyze the opinion of a group of users. Both models take as input the evaluations of the users and provide an aggregated value for the image and an aggregated value for each tag. The first model computes simply the average of existing values. The second model is based on a multiple criteria procedure in which one has to choose between two alternatives: recommending/accepting an image and rejecting it. The model prefers the alternative that satisfies more criteria (tags in our case), i.e. the one with more arguments pros. Note that in the application, all the tags are assumed to be equally important.

Definition 4 (Opinion aggregation) *Let* $Ag = \{u_1, \ldots u_n\}$ *be a set of users,* $im \in \mathcal{I}$ *where* $\mathcal{F}(im) = \{t_1, \ldots, t_m\}$*. The next table summarizes the opinions of the* n *users.*

Users/Tags	t_1	$\ldots$	t_j	$\ldots$	t_m	im
u_1	$v_{1,1}$	$\ldots$	$v_{1,j}$	$\ldots$	$v_{1,m}$	r_1
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
u_i	$v_{i,1}$	$\ldots$	$v_{i,j}$	$\ldots$	$v_{i,m}$	r_i
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
u_n	$v_{n,1}$	$\ldots$	$v_{n,j}$	$\ldots$	$v_{n,m}$	r_n

The result of the aggregation is:

Group	v_1	$\ldots$	v_j	$\ldots$	v_m	r

where for all v_i, $v_i = \sum_{j=1,n} v_{j,i}/n$, *and*

Average operator: $r = \sum_{j=1,n} r_j/n$

MCD operator: $r = \begin{cases} 1 & \textit{if} \, |\{t_j \mid v_j > 0\}| > |\{t_k \, |v_k < 0\}| \\ 0 & \textit{otherwise} \end{cases}$

Note that the first aggregation operator assigns a value from the set $\mathcal{S}$ to an image while the second one allows only binary values: 1 (for acceptance) and 0 (for rejection).

It is worth mentioning that even if both models aggregate in the same way the values of the tags, they do not necessarily rate in the same way the image. The following example shows a case where one operator accepts an image while the second rejects it.

Example 2 *Let us consider the following opinions expressed by four users about an image* im *where this image is described by four tags.*

Users/Tags	t_1	t_2	t_3	t_4	im
u_1	*0.9*	*0.7*	*-0.2*	*-0.3*	*0.5*
u_2	*0.5*	*0.6*	*-0.5*	*0.2*	*-0.2*
u_3	*-0.5*	*-0.3*	*-0.2*	*0.9*	*-0.6*
u_4	*0.1*	*0.2*	*0.3*	*-0.6*	*0*

The aggregated values of the tags are respectively: 0.25, 0.3, -0.15, and 0.05. The average operator assigns value -0.075 to the image whereas the MCD operator accepts the image (the overall rating is 1). This discrepancy is due to the fact that the decision model of each user is unknown. Indeed, it is not clear how a user aggregates the values he assigns to tags in order to get an overall rating of an image. For instance, user u_2 *likes most of the tags, however he rejects the image. This means that either he has in mind other tags which are not considered in the table, or gives a higher importance to tag* t_3*. The second reason of discrepancy is that the second model does not take into account the overall recommendations of the users.*

Finally, it is worth noticing that opinion analysis amounts to aggregating arguments pros/cons a given target into a new argument. In the previous example, the four arguments $((t_1, 0.9), im)$, $((t_1, 0.5), im)$, $((t_1, -0.5), im)$ and $((t_1, 0.1), im)$ are aggregated into a new argument $((t_1, 0.25), im)$. This argument is pro the image im while it is based on argument $((t_1, -0.5), im)$ con the same image.

5. Group Decision Making

In the previous sections, we have mainly presented the architecture of the system and described the reasoning part of the users and of the agents in the system. In what follows, we focus on the reasoning of the group. We provide a negotiation protocol that allows agents to make joint decisions. The idea is the following: a session starts when a user invites other users for sharing an experience online. When the invited users accept, a request is sent to the Media Server agent that will compute the best image and send it to the WeShare agents. These agents display the image to all the users. Each user expresses his opinion about the image and the tags via the WeShare interface. WeShare agents provide to their respective users a report on the aggregated opinion of the other agents. Users may consider this information for revising their own opinions. In case all agents agree on the overall rating of the image, then the image is bought (or stored) and the session is over. In case of disagreement, pairs of users may engage in private dialogues where they exchange arguments (as in Definition 3) about the image. The exchanged arguments may be either the ones that are built by the user when introducing his opinion or new ones. Actually, a user may add new tags for an image. When the disagreement persists, the preferences (about tags) are aggregated and the result is sent to the Media Server in order to select a new image that suits better those preferences.

In what follows, $Ag = \{u_1, \ldots, u_n\}$ is a set of users, and $\texttt{Args}^t(u_i)$ is the set of arguments of user u_i at step t. At the beginning of a session, the sets of arguments of all users are assumed to be empty (i.e., $\texttt{Args}^0(u_i) = \emptyset$). Moreover, the set of images contains all the available images in the database of the museum, that is $\mathcal{I}^0 = \mathcal{I}$. We assume also that a user u_i is interested in having a joint experience with other users. The protocol uses a communication language based on four locutions:

- `Invite`: it is used by a user to invite a set of users either for sharing an experience or for engaging in a dialogue.
- `Send` is used by agents for sending information to other agents.
- `Accept` is used mainly by users for accepting requests made to them by other users.
- `Reject` is used by users for rejecting requests made to them by other users.

Interaction protocol:

1. $\texttt{Invite}(u_i, G)$ (user u_i sends an invitation to users in G where $G \subseteq Ag$). User u_i is the Administrator of the session.
2. Each user $u_j \in G$ sends either $\texttt{Accept}(u_j)$ or $\texttt{Reject}(u_j)$. Let $G' \subseteq G$ be the set of agents who answered positively to the invitation.
3. If $G' = \emptyset$, then either go to Step 4 (in case the user u_i decides to have the experience alone), or the session is over.
4. `Send`(WeShare$_i$, {Media Server}, $\langle \mathcal{P} = \emptyset, \mathcal{R} = \emptyset, \mathcal{I}^t \rangle$) (the WeShare agent of user u_i sends a request to the Media Server agent).
5. `Send`(Media Server, {WeShare$_{i=1,\ldots,n}$}, $\texttt{Best}(\mathcal{I}^t)$) (the Media Server agent computes $\texttt{Best}(\mathcal{I}^t)$ and sends it to all the WeShare agents).
6. Each WeShare agent displays the image $\texttt{Best}(\mathcal{I}^t)$ and its tags (i.e., $t_i \in \mathcal{F}(\texttt{Best}(\mathcal{I}^t))$).
7. Each user $u_j \in G' \cup \{u_i\}$:

   (a) bids the tags and gives an overall rating $\texttt{Res}_j(\texttt{Best}(I^t))$ to the image. Let $\texttt{Args}_j^t = \texttt{Args}_j^{t-1} \cup \{((t_i, v_i), \texttt{Best}(I^t)) \mid t_i \in \mathcal{F}(\texttt{Best}(I^t))\}$ be the set of arguments of user u_j at step t.

(b) The Deliberating agent of u_j computes the opinion of the group $(G' \cup \{u_i\}) \setminus \{u_j\}$ using the average or MCD operator. Let $\langle (t_1, v_1), \ldots, (t_k, v_k), (r, v) \rangle$ be the result of the aggregation.

(c) The user u_j may change his bids in light of $\langle (t_1, v_1), \ldots, (t_k, v_k), (r, v) \rangle$. Thus, the set $\mathtt{Args}_j^t$ is revised accordingly. All the arguments that are modified will be replaced by the new ones. Let $\mathcal{T}' \subseteq \mathcal{F}(\mathtt{Best}(I^t))$ be the set of tags whose values are modified. Thus, $\mathtt{Args}_j^t = (\mathtt{Args}_j^t \setminus \{((t, v), \mathtt{Best}(I^t)) \in \mathtt{Args}_j^t \mid t \in \mathcal{T}'\}) \cup \{((t, v'), \mathtt{Best}(I^t)) \mid t \in \mathcal{T}'\}$.

(d) When the user u_j is sure about his bids, he clicks on a 'Send' button (on the WeShare interface).

8. If for all $u_j \in G' \cup \{u_i\}$, $\mathtt{Res}_j(\mathtt{Best}(I^t)) > 0$, then the session is over.
9. If for all $u_j \in G' \cup \{u_i\}$, $\mathtt{Res}_j(\mathtt{Best}(I^t)) < 0$, then go to Step 12.
10. For all $u_j, u_k \in G' \cup \{u_i\}$ such that $\mathtt{Res}_j(\mathtt{Best}(I^t)) > 0$ and $\mathtt{Res}_k(\mathtt{Best}(I^t)) < 0$, then:

(a) $\mathtt{Invite}(u_j, \{u_k\})$ (user u_j invites user u_k for a private dialogue).

(b) User u_k utters either $\mathtt{Accept}(u_k)$ or $\mathtt{Reject}(u_k)$.

(c) If $\mathtt{Accept}(u_k)$, then $\mathtt{Send}(u_j, \{u_k\}, a)$ where a is an argument, $\mathtt{Conc}(a) = \mathtt{Best}(I^t)$ and either $a \in \mathtt{Args}_j^t$ or $\mathtt{Tag}(a) \notin \mathcal{T}$ (i.e., the user introduces a new argument using a new tag).

(d) User u_k may revise his opinion about $\mathtt{Tag}(a)$. Thus, $\mathtt{Args}_k^t = (\mathtt{Args}_k^t \setminus \{((\mathtt{Tag}(a), v), \mathtt{Best}(I^t))\}) \cup \{((\mathtt{Tag}(a), v'), \mathtt{Best}(I^t)) \mid v' \neq v\}$.

(e) Go to Step 10(c) with the roles of the agents reversed (the exchange stops either when the users have no more arguments to send or one of the users decides to exit the dialogue).

11. If $\exists u_j, u_k \in G' \cup \{u_i\}$ such that $\mathtt{Res}_j(\mathtt{Best}(I^t)) > 0$ and $\mathtt{Res}_k(\mathtt{Best}(I^t)) < 0$, then Go to Step 12, otherwise Go to Step 8. (In this case, even after a phase of bilateral persuasion, two users still disagree on the final rating of the current image).
12. Go to Step 4 with:

- $\mathcal{P} = \{t \in \mathcal{F}(\mathtt{Best}(I^t)) \mid \forall u_j \in G' \cup \{u_i\}, \exists a \in \mathtt{Args}_j^t$ such that $\mathtt{Tag}(a) = t, \mathtt{Val}(a) > 0,$ and $\mathtt{Conc}(a) = \mathtt{Best}(I^t)\}$,
- $\mathcal{R} = \{t \in \mathcal{F}(\mathtt{Best}(I^t)) \mid \forall u_j \in G' \cup \{u_i\}, \exists a \in \mathtt{Args}_j^t$ such that $\mathtt{Tag}(a) = t, \mathtt{Val}(a) < 0,$ and $\mathtt{Conc}(a) = \mathtt{Best}(I^t)\}$,
- $\mathcal{I}^{t+1} = \mathcal{I}^t \setminus \{\mathtt{Best}(\mathcal{I}^t)\}$.

These sets are computed by the Deliberating agent of the Administrator of the session.

It is worth mentioning that when a user does not express opinion about a given tag, then he is assumed to be indifferent wrt. that tag. Consequently, the value 0 is assigned to the tag.

Note also that the step 10(a) is not mandatory. Indeed, the invitation to dialogue is initiated by users who really want to persuade their friends.

The previous protocol generates dialogues that terminate either when all the images in the database of the museum are displays, or when users exit, or when they agree on an image; This means also that the outcome of a dialogue may be either an image on which all users agree or a failure.

6. Conclusions

This paper proposed a system that allows a group of users to have a shared online cultural experience. In our system several users are provided synchronously with images from the digital collection of a museum. Users can then express their own opinions about each image, and finally make joint decisions about whether or not to accept the image (so as, for example, to buy a hardcopy of that image for another friend). The system has two main components: a Media Server agent which connects to the museum and provides images, and WeShare agents through which users interact with the system and with each other. Finally, although not explicitly covered in the paper, a lightweight version of a peer-to-peer Electronic Institution is responsible for the multiple interactions between the two other components.

From a reasoning point of view, the application involves two multiple criteria decision problems: one at the level of each user and one at the level of the group. Both decision problems are about accepting or not an image sent by the museum shop server. Users individually make their decisions in a non-automatic way through the WeShare interface. However, they are assisted by a software agent which provides an aggregated view of the opinion of the group. This may later be taken into account by the user in order to revise his choices. Two aggregation operators are defined: the first one computes the average of the preferences of the different users whereas the second one applies a multiple criteria aggregation. The decision of the group is made after a negotiation phase where each user tries to persuade other users to change their preferences.

We are currently at the beginning of a European Project and plan to improve the system in a number different ways. The first line of our research with respect to the work described in this paper concerns the aggregation operator that may be used in opinion analysis. We are investigating the possibility of using more sophisticated operators such applying a multiple criteria aggregation of the data provided by each user and then to aggregate the result. Another idea consists of considering weighted tags and providing users with the ability to weight their preferences using HCI devices such as the speed or length of time they press a tag during an online session. More future work consists of us extending the negotiation architecture in order to allow the exchanging arguments built from pre-existing domain ontologies.

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