A User Interface to Support Dialogue and Negotiation in Participatory Simulations

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Abstract. In this paper, we discuss the process of analysis and design of a user interface to support dialogue and negotiation between players of participatory simulations. The underlying context is an interdisciplinary project, named SimParc [8], about participatory management of protected areas for biodiversity conservation and social inclusion. This project is inspired by the ComMod MAS/RPG approach [6] and by recent proposals for software support for distributed role playing games, such as those by Guyot [14] and by Adamatti [1]. In this paper, we focus on the analysis and design of a user interface to ease and structure dialogue and negotiation between players, using a methodology based on semiotic engineering. Our main objective is to try to find a good balance between the necessary structuring and the spontaneity of dialog and negotiation.

1 Introduction

One of the principles of the Convention on Biological Diversity [15] refers to a participative process of social actors in the management of the biodiversity. Methodologies and computer-supported tools intending to facilitate this process have been addressed via bottom-up approaches that emphasize the role of local actors (stakeholders) and communities. Such bottom-up approaches echo the research conducted by members of the "ComMod" (for Companion Modeling) movement on participatory methods to support negotiation and decision-making for collective management of natural renewable resources. Their method, called MAS/RPG, consists in coupling multi-agent simulations (MAS) of the environment resources and role-playing games (RPG) by the stakeholders [6].

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Our project inherits from this tradition. It is named "SimParc" (which stands for "Simulation Participative de Parcs") and gathers French and Brazilian researchers in an inter-disciplinary approach. It constitutes an innovative and playful approach to explore and learn about negotiation procedures in national park management, based on the recognition of conflicts involving different interests, roles, and strategies. SimParc explores the use of advanced accompaniment methodologies based on MAS/RPG. More precisely, it follows recent proposals of integration of role playing into simulation, and of inserting artificial agents, as players [1] or as assistants [14]. In this paper, we focus on the user interface support for dialogue and negotiation between game players, and on the process of its analysis and design, by using a methodology for designing human computer interfaces based on a HCI theory named semiotic engineering.

2 The SimParc Project

2.1 Motivation

The SimParc project focuses on participatory management of parks and protected areas.[1] Our first concrete case study has been the urban National Park of Tijuca, in Rio de Janeiro, Brazil. It undergoes a real pressure, by urban growth and illegal occupation. This makes the question of the conflict resolution one of the key issues for the management of the park. Examples of inherent conflicts are: irregular occupation, inadequate tourist exploration, water pollution, degradation of the environment and illegal use of natural resources. Examples of social actors involved are: park managers, researchers, traditional or non traditional community representatives, tourist operators and agencies.

The design of our current role playing game has taken inspiration in real cases such as the National Park of Tijuca, in order to bring concrete elements to the game, which confers greater applicability to our proposal. However, we chose not to reproduce a real case but to simulate emblematic and illustrative real situations in national parks.

2.2 Objective

The SimParc game constitutes an innovative and playful approach to support negotiation procedures in national parks management. Current game has a pedagogical objective and is not (or at least not yet) aimed at decision support.[2] The targeted public includes managers of parks and protected areas, researchers, students, and all stakeholders and people willing to understand and explore the

[1] Parks are one among the different types of protected areas, as defined by Brazilian legislation. Other examples of types are, e.g., biosphere reserves or ecological stations [15].

[2] Current game is aimed at helping participants to discover and explore conflicts as well as negotiation strategies to address them. But we do not expect the resulting decisions to be directly applied to a specific park. This would require, e.g., a precise calibration and a predictive model for park viability. This is left for future work.

challenges, conflicts and process of negotiation for participative management of parks and protected areas.

The game is based on the process taking place within the council of the park. This council, consultative, includes representatives of various stakeholders (e.g., traditional community, tourism operator, environmentalist non governmental association, water public agency...). The actual game focuses on a discussion within the council about the demarcation ("zoning") of the park. More precisely, it is about the decision to associate a type of conservation (and therefore, use) to every sub-area[3] (named "landscape unit") of the park. We consider nine pre-defined potential types of conservation/use, from more restricted to more flexible, as defined by the law.

The game considers a certain number of players roles, each one representing a certain stakeholder. Depending on its profile and the presence of elements of concerns in some of the landscape units (e.g., tourism spot, people, endangered species...), each player will try to influence the decision about the type of conservation for each landscape unit. It is clear that conflicts of interest will quickly emerge, leading to various strategies of influence and negotiation (e.g., coalition formation, trading mutual support for respective objectives...).

The manager of the park observes the negotiation taking place and takes the final decision for types of conservation for each landscape unit, based on the legal framework, on the process of negotiation between players, and on his personal profile (e.g., more conservationist or more open to social concerns) [15]. He also may have to explain his decision, on demand from the players. The park manager may be played by a human, or by an artificial agent [9].

In summary, the objective of the project is thus to propose an epistemic process to help each participant discover and understand the various factors, conflicts, and the importance of dialogue for a good management of protected spaces.

2.3 Steps

The game is structured along six steps, as illustrated at Figure 1. At the beginning (step 1), each player is associated to a role. Then an initial scenario is presented to each player, including the setting of the landscape units, the possible types of use and the general objective associated to his role. Then (step 2), each player decides a first proposal of types of use for each landscape unit, based on his understanding of the objective of his role and on the initial setting. Once all done, proposals by players are made public to all. In step 3, players start interacting and negotiating about their proposals. This step is, for us, the most important, where players will collectively build their knowledge by means of argumentation process. In step 4, they revise and commit to their proposals. In step 5, the park

[3] We suppose that the process of identification of (or, decomposition into) the landscape units of the park has already taken place before. Actually, the two processes were considered simultaneously in an initial version of the game, but this proved too complex. Moreover, deciding the type of conservation alone is sufficiently effective to capture conflicts and negotiation between stakeholders.

manager makes the final decision, considering the process of negotiation, the final proposals and also his personal profile (e.g., more conservationist or more sensitive to social issues). Each player can then consult various indicators of his/her performance (e.g., closeness to his initial objective, degree of consensus, etc.). He can also ask for explanation of the park manager decision rationales. The last step (step 6), "closes" the cycle and provides a feedback on the decision, both by the players (indicating their level of acceptance of the decision) and some evaluation of the quality and of the decision through indicators (e.g., on the economical or social feasibility) or simulation.

A new cycle of negotiations may then possibly start (see Figure 1), thus creating a cycle similar to a learning cycle [17]. The main objective is indeed for participants to: understand the various factors and perspectives involved and how they are interrelated, negotiate to try to reach a group consensus, and understand cause-effect relations based on decisions.

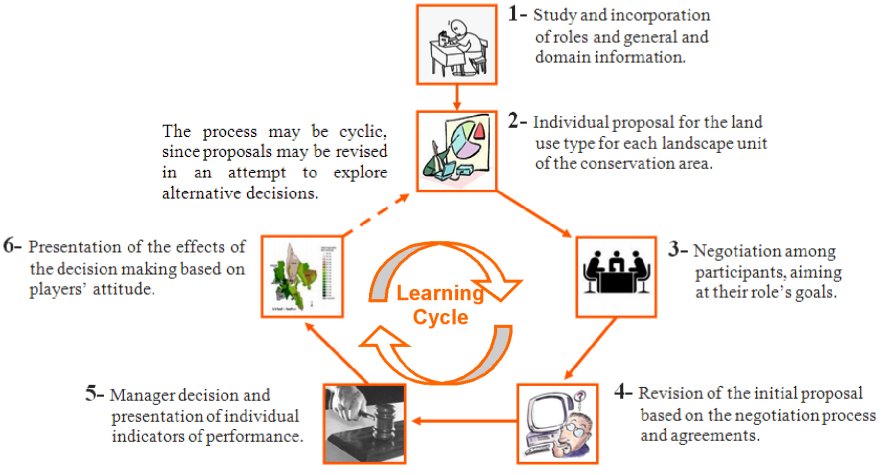

Fig. 1. The 6 steps of SimParc game

2.4 Game Computer Support

A computer support is proposed for the game, allowing distributed role playing, where each player acts and interacts via a computer interface, as has been pioneered by Simulación [14] and ViP-GMABS [1]. In SimParc, the role playing game is completely distributed and the master of the game will be automated, in part or completely. Because all interactions, decisions and actions are mediated by the computer, they can be formatted as objects, recorded and processed on-line or off-line to allow the management of the history of the negotiations (different ways of visualization of exchanged messages) and to evaluate and analyze the players and the negotiation process. In section 5, we will discuss the

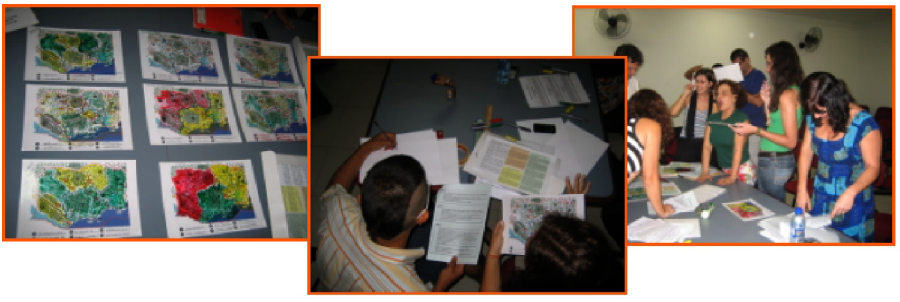

Fig. 2. Test of the SimParc game version 1

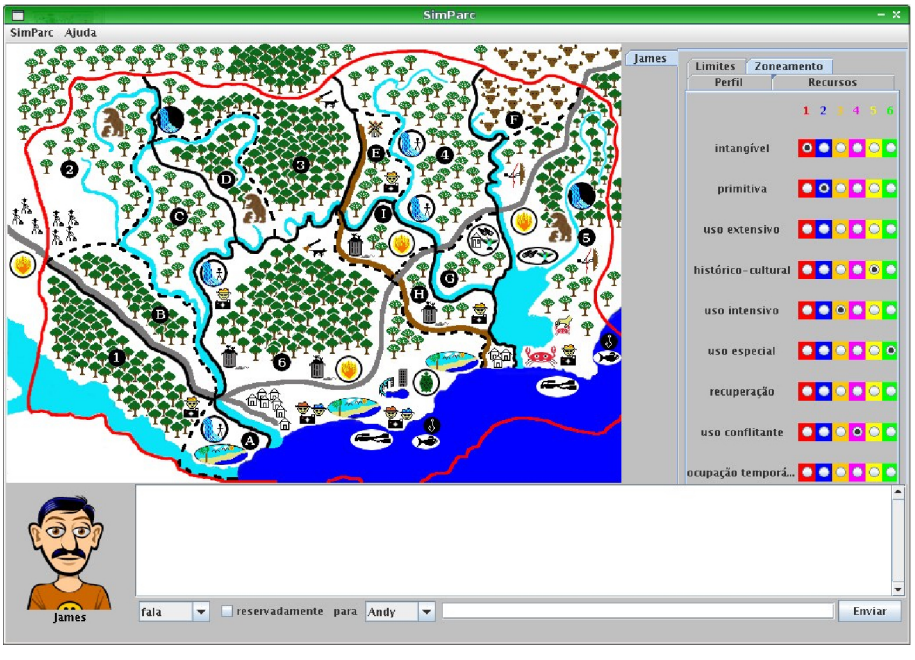

Fig. 3. SimParc game version 1 first computer-support prototype

interface support for the negotiation process. We are also working on introducing artificial agents in the game: (1) an automated park manager taking decision and explaining it, (2) artificial players [1], (3) assistants to the players [14], as discussed in [9] and in future publications.

2.5 Versions and Experiments

The initial design of the game (version 1) was conducted during year 2007. It was tested, without any computer support, through a game session conducted

in September 2007 (see Figure 2). There were six roles in the scenario. Each role was played by a team of two players. Players were researchers and students of the APIS (Áreas Protegidas e Inclusão Social – Protected Spaces and Social Inclusion) research group, at UFRJ (Rio de Janeiro), led by Marta Irving, and specialized in biodiversity participatory management.

In parallel, a fist computer support prototype, based on the framework Simulación [14] was designed and built (see Figure 3).

Based on the evaluation of the first version of the game – notably via the analysis of the test of September 2007 – and on the evaluation of its computer-support prototype, we then designed a second version of the game, with a new computer support prototype under current construction. Among some specific features (artificial agents and automated evaluation of players performance), it provides some support for structuring interaction and negotiation among players. We will now discuss how it has been analyzed and designed.

3 Analysis and Design Process

The process of design was based on communication-centered design, and its more agile version, eXtreme Communication-Centered Design [3], design proposals based on the semiotic engineering theory of human-computer interaction.[4] We adapted the application of the methodology to the characteristics of the SimParc project. Figure 4 shows the different phases and sub-phases adopted.

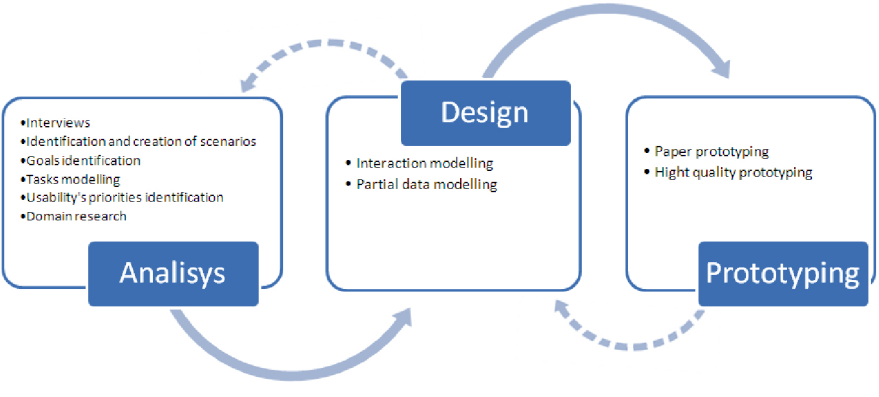

Fig. 4. The process of design

The output products of the analysis phase are the records from interviews with experts and users, scenarios (use cases), goals diagram and tasks model.

[4] According to it, both designers and users are interlocutors in an overall communication process that takes place through the interface of the system. Designers must tell users what they mean by the artifact they have created, and users must try to respond to what they are being told [22].

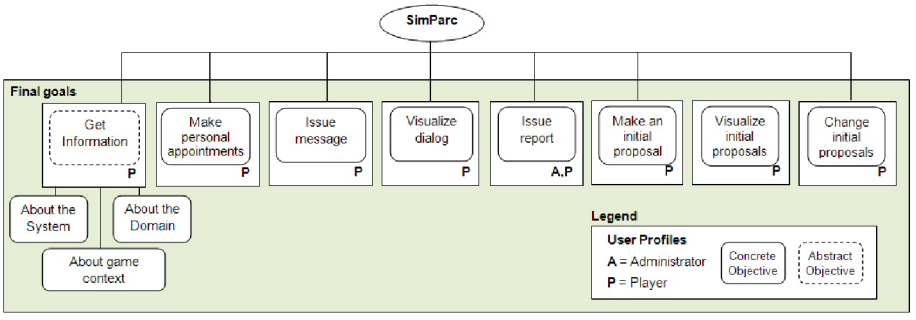

Fig. 5. The MoLIC diagram of final goals

The scenarios were constructed based on interviews, in a narrative form, to help at identify contextualized types of usages. The goals diagram (see Figure 5,[5] modeled in the MoLIC language (MoLIC stands for Interaction Modeling Language for the Conversation), was constructed from the scenarios and interviews, with the aim of representing the goals (identified a priori) of the users. We believe that the task model represents an intermediary step, easing a conceptual transition from the analysis phase (what, why and by whom) to the design (how). Note that task models are also widely used and accepted in human-computer interaction (HCI) [4]. Overall, the goal of the diagrammatic representation of task models is to provide an overview of the design process for each goal and how these goals are decomposed into tasks and sub-tasks. This diagram provides a new set of information about the process, presenting the hierarchy and flow of tasks, preparing designers and users to an outline of the interaction. We used an adaptation of the Hierarchical Task Analysis (HTA) [2] for modeling tasks identified from the goals diagram and the scenarios.

4 Design of an Interface Language for Negotiation Support

We consider negotiation as a particular form of communication process between two or more parties, focused on mutual agreement(s) on a given conflict of interest or opinions [18]. We further believe that the adoption of an interface language, based on argumentation models and linguistics theory, can offer different ways of support to a computer mediated negotiation process. The main objective for that interface language is to find the inflection point between the necessary "framing" and the maintenance of fluidity and naturalness of the dialogue.

The structure of the dialogue is an important factor, because it helps at a better management of the history of the negotiations facilitating the inclusion

[5] Because of the space limitation, we only illustrate some of the notations/diagrams. Figure 5 shows the final goals diagram. Note that there is also an instrumental goals diagram [5].

of artificial agents in the process, increasing the focus on the process, on issues negotiated and on the clarity of dialogue. Many interaction protocols for negotiation between agents have been proposed (e.g., via the FIPA-ACL effort), but they privilege the agent- agent communication at the expense of human communication. Note also that computer mediated communication suffers from various types of impoverishment of the dialogue, particularly in relation to non-verbal communication, considering the body language [10] and the vocal intonation. Thus, we are looking for an intermediate and simple way to promote both human-human and human-agent communication.

We considered many proposals of notation for structuring and visualization of the argumentation, as, e.g., in [16]. Among them: the Toulmin model, a reference for the majority of the posterior models; the Issue-Based Information System (IBIS), an informal model based on a grammar that defines the basic elements present in dialogues about decision-making; the "Questions, Options and Criteria" (QOC); the "Procedural Hierarchy of Issues" (PHI) and the "Decision Representation Language" (DRL) [16]. Based on this analysis, we believe that it is possible to offer a pre-structure, adding to the informal and interpretative characteristic of prose, while maintaining the fluidity of dialogue. Our main inspirations for rhetorical markers is IBIS [16], as well as theories of negotiation, e.g., [23] [19] and Speech Act Theory [21]. These markers are basically composed of rhetorical identifiers of intention (see Figure 6), the object focus of the intention and of a free speech (see Figures 8.3 and 8.4). These elements give the tone of the dialogue, making clear the illocution, and thus facilitating the expression of the desired perlocution [21].

We therefore provide the structure by threading from the dialogue, which minimizes risks of losing context, common in computer mediated communication (via chat) [12]. Figure 7 shows an example of threading based on the proposed structure.

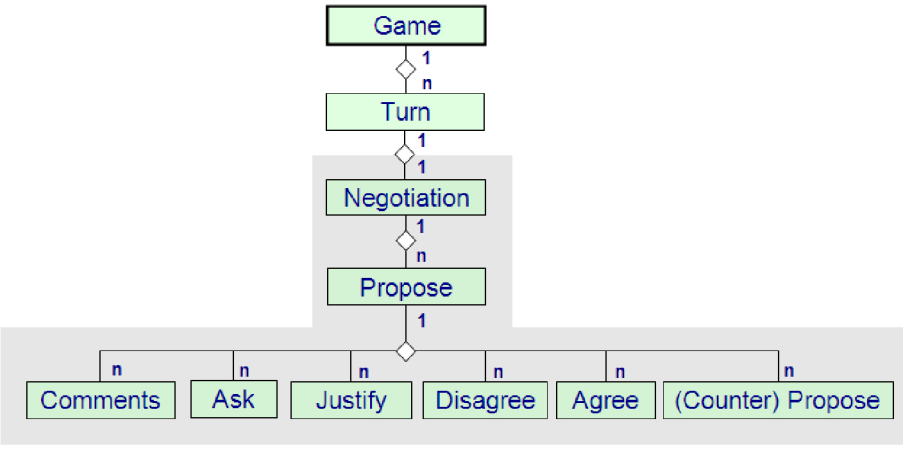

Fig. 6. Semi-structure for the text based on rhetorical markers

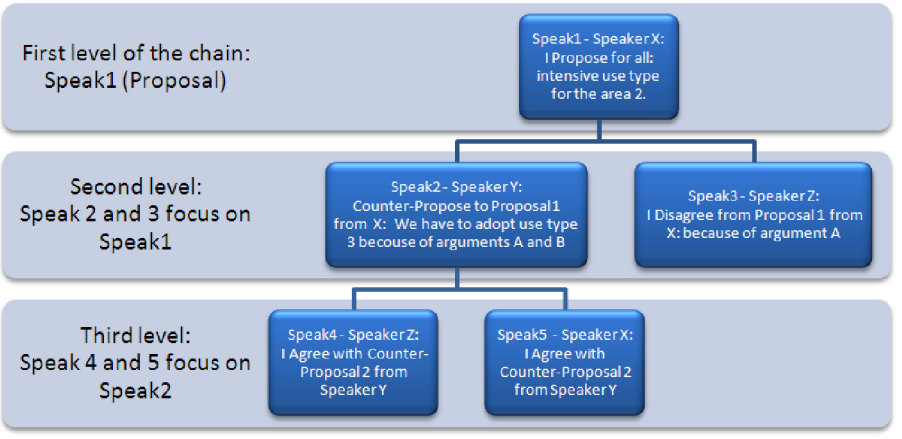

Fig. 7. Example of threading structured by the rhetorical markers

In complement to this semi-structure applied to the text, we propose to model each speak from players as an object. These objects have the following attributes: identifier, sender, receiver(s), marker, focus, and a free text (See Figure 7). This modeling eases at the management and indexing of dialogue by the system. For instance, filters may be applied to analyze the history of a dialogue, e.g., filtered along a given speaker, or a specific type of marker. But it also opens the way for its processing by software agents.

5 Prototype

The outputs of the design phase are: interaction diagrams, class diagrams, class and entity relationship model for the database. We then created a fast prototype in order to evaluate the appearance and usage. In the following we focus on the prototype interface corresponding to step 3 of the game, i.e., negotiation between players. It is indeed a central part of the game, when the shared knowledge is jointly negotiated and built. We would like to emphasize that we try to balance a support for some structure of the text of the dialogue and also sufficient fluidity.

The prototype user interface (see Figure 8) includes an area (Fig. 8.1) for the history of messages exchanged. The area (Fig. 8.2) for managing the history of messages offers different ways of selecting and ordering the information and includes a simple way to better identify speakers (discrimination by color). The area (Fig. 8.3) contains options for semi-structure of messages via rhetorical markers for intention (e.g., disagree). The area (Fig. 8.4) is for writing the actual contents (text) of the message. The area (Fig. 8.5) allows selecting the recipients (unique or multiple) of the message to be sent. The area (Fig. 8.6) provides the selection of iconic expressions to offer an alternative way for the user to express his emotional context during the negotiations, as an alternative way of minimizing the loss of communication modalities. The “facecons” were produced from

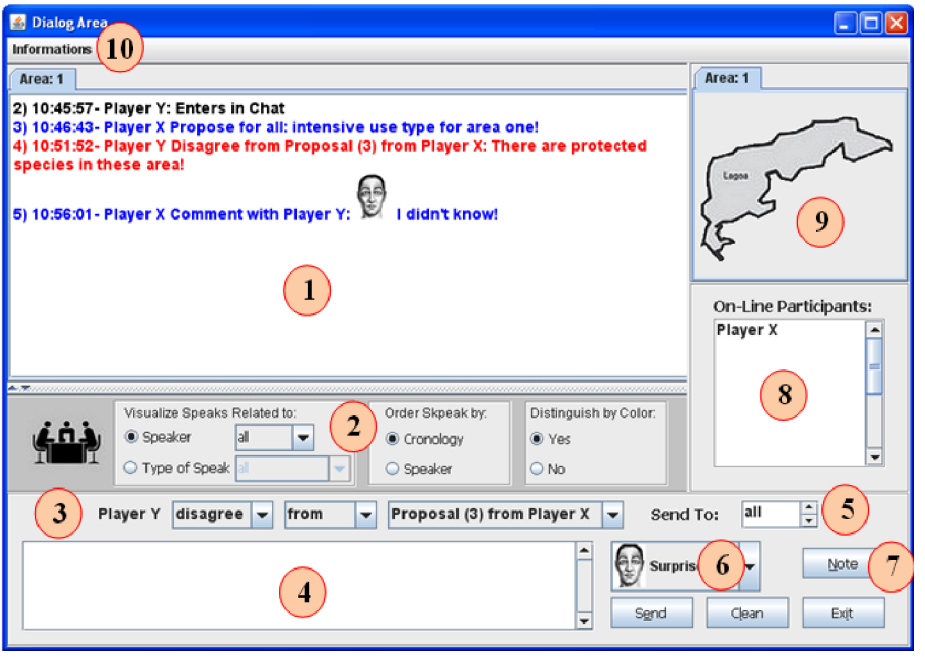

Fig. 8. Prototype interface for the negotiation step

the tool Artnatomia [11] which generates iconic facial expressions of emotional states from the virtual manipulation of the muscles of the face.

There is an area (Fig. 8.7) for personal annotations, allowing the user to make and record personal notes during the negotiation (this need was observed during test with players, see Figure 2). There is also an area (Fig. 8.8) with the list of participants and their roles that, in accordance with the C3 (Communication, Coordination and Cooperation) model [13], is a form of support for coordination. There is an area (Fig. 8.9) with the view of the object negotiated and its geo-processed representation. Last, menus (Fig. 8.10) are available with access to different types of information about the domain, the system and the context of the game, such as the legal types of land use, the roles, the game objective and phases, the system use and help.

6 Discussed and Open Issues

We now address some of the issues that were discussed during the workshop as well as issues that we encounter during our project.

6.1 Scope and Realism of the Simulation

Our objective is social simulation, based on a role playing game, including human actors playing some roles in a simulated situation of conflicts, negotiation and

decision making. Our scenario for the role playing game has taken inspiration in real cases, such as the National Park of Tijuca, although it is not the reproduction of a real case. Real cases are important, because they bring concrete elements to the game, which allows our proposal to be evaluated in more realistic and illustrative settings. However, we chose not to reproduce exactly a real case, in order to leave the door open for broader game possibilities [9] [15].

The last step (step 6) of the game (see Figure 1) "closes" the cycle (and the epistemic loop) by considering the possible effects of the decision. In the current game, the players provide a simple feedback on the decision by indicating their level of acceptance of the decision. For a future version, we also plan to introduce some evaluation of the quality of the decision through computable indicators (e.g., on the economical or social feasibility). An alternative is a multi-agent simulation of the evolution of resources. We have not yet addressed this additional (and more traditional) type of simulation, because our current project main focus is on social simulation, negotiation and decision support. We are also aware that modeling the resources and their evolution (flora, fauna, water, animals, population and their activities) is always a challenge. It also triggers the issue of realism and predictiveness. In our project current stage, we are concerned with credibility and not yet with realism because our objective is epistemic and not about producing an (hypothetical) optimal decision.

6.2 Towards Hybrid Simulation

As already mentioned in Section 2.4, we are planning to introduce artificial players into the game [9]. The idea is to possibly replace some of the human players by artificial players (artificial agents). The social simulation will therefore become hybrid, with human and artificial agents in the simulation. A first motivation is to address the possible absence of sufficient number of human players for a game session [1]. But this will also allow more systematic experiments about specific configurations of players profiles, because of artificial players objective, deterministic and reproductible behaviors.

6.3 Hybrid Negotiations

An important and difficult issue for negotiation models is to reach some balance between human players needs and artificial players requirements. Negotiation languages for human players is usually richer and/but also more ambiguous. Negotiation languages for artificial players are usually more restricted in order to be unambiguous and interpretable by machine. In our project, we are currently exploring in parallel the two dual ways: (1) structure human negotiations though language and interface support and observe them (see Section 4); (2) design artificial players/negotiations, and insert/test them (see [1] [9]). Our mid-term goal is to gradually better understand human negotiation and see how to find a compromise with automated negotiation requirements.

6.4 From Modeling to Simulation and from Simulation to Modeling

One of the key issue of computational modeling and simulation of complex phenomena is about extracting knowledge about the phenomena, in our case social actors and social processes. This means the elicitation of models of representation, models of interaction and models of decision. Traditional approach used in social sciences and in computational modeling and simulation of social processes use observation and transcription of social actors behaviors in the real world, by using an ethnographic approach and also surveys based on interviews.

An alternative (participatory simulation, see e.g., [14]) is to directly involve human social actors as elements of the computer supported simulation of this social process. Computer supported role playing games create simulated situations in which social actors are immersed, can play their roles and expose their behaviors and strategies. Indeed, role-playing games are "social laboratories", because players can try many possibilities, without real consequences [6]. This leads to a more natural incremental modeling of the social process and of the behaviors of the social actors.

We then may gradually replace human actors by artificial agents (see Section 6.2), the human actors validating or amending the behaviors of artificial players. These artificial players may be programmed at hand (see, e.g., in [1]) or inferred by automated analysis of the human players. Indeed, the fact that the role playing game is distributed and that players interact through computers allows the systematic memorization of all interactions and decisions taking place between players. This opens the way for some automated or semi-automated analysis of traces of interactions [14] [8], in order to infer behavioral models. This means that elicitation (knowledge extraction) of human experts behavioral models (e.g., models of interaction, decision and negotiation) may be conducted via automatic monitoring of experts in (virtual/simulated) situation/action, as opposed to more traditional interview-based (off situation) elicitation. We believe that this represents of some kind of "virtuous circle", where modeling and simulation incrementally reinforce each-other.

7 Conclusion

In this paper, we have presented and discussed the process of analysis and design of a prototype user interface to support dialogue and negotiation for participatory simulations, for the domain of protected areas management. An important objective for the interface is to explore some balance between structuring dialogue and negotiation, e.g., through rhetorical markers, and keeping some fluidity. Our current prototype is under completion and we will soon start to test it by organizing game sessions with players expert in the domain of the game. We are planning to use epistemic tools proposed by semiotic engineering (which was used for the analysis and design phases) to test and evaluate the acceptance and usability by users during game sessions. We also plan to study the possible generality of some of the principles of our prototype interface for other types and domains of participatory simulations and serious games.

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