An Online ADR System Using a Tool for Animated Agents

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Abstract: We describe an online ADR (Alternative Disputation Resolution) System using a tool for generating facial expressions of animated agents. In this system, a participant of ADR disputes against an opponent through a computer network. The participant agent searches similar cases of arguments and supports the participant by showing the similar cases. The participant edits the next proposal by referring to the cases. And the agent learns the participant's tendency to select facial expressions, based on an emotional model, and generates the facial expression. The participant can reduce the cost of the dispute by using the participant agent.

Keywords: animated agent, human interface, facial expression, Alternative Disputation Resolution, case based reasoning

1. Introduction

An ADR is a method of resolving disputes without trial. A mediation, an arbitration and a conciliation are typical ADRs. As an ADR can resolve a disputation faster and cheaper than a trial, the demand for ADR increases. Recently, online ADR systems have been developed in order to deal with more demands. These systems receive consultations by e-mails, and disputations are solved by exchanging e-mails between a consultant and a client. Sometimes consultations go into the mediation where two clients (participants) and the consultant (mediator) exchanges emails until agreement is achieved.

Current online ADRs have several problems. At first, the participants are not used to online discussions. Online discussions are performed by exchanging only texts, which is different from face-to-face discussions. Usually, it takes much time to reach agreement because participants don't have non verbal information.

Secondly, participants don't have enough information about the trouble. If they have knowledge about legal rules or commercial customs, the disputation will be solved faster.

To deal with these problems, we developed an online ADR system, AMAS (agent mediated ADR support system) which is navigated by agents. This system consists of two parts, an online discussion environment, and a participate agent. The discussion environment has a user interface where non verbal information is transferred by the facial expression of an animated agent. A participant agent helps the participant to make arguments by referring to old cases. This agent controls the facial expression of the animated agent instead of the participant in detail.

Generally, people use two kinds of facial expressions in negotiation [1)]. The one is an unintentional facial expression, which reflects a human's emotional state directly. The other is an intentional facial expression, which is controlled intentionally according to some negotiation strategy. We assume that the facial expressions depend on each personality of a human. Therefore, we developed TAA (a Tool for Animated Agent), which learns the personality of the participants by Bayesian network, and generates unintentional facial expressions automatically.

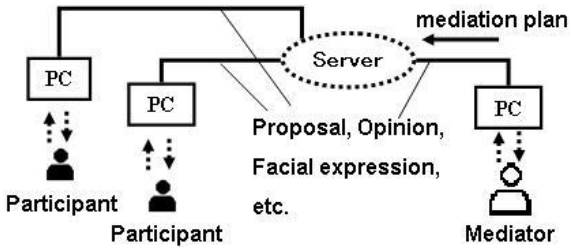

Fig. 1: Overview of AMAS

In Section 2, we describe an overview of our online ADR system. Section 3 presents a participant agent, which assists participants. The emotional model in the architecture and experimental results are shown in Section 4. Section 5 shows an example of searching a similar case and how to use it. Finally, Section 6 is the concluding remarks.

2. Overview of AMAS

In this section, we describe an overview of AMAS. The process of AMAS consists of three phases. In phase One, the system receives a trouble case from a client, and it gives an advice to resolve a trouble by showing a suitable flowchart. Fig.2 shows an example of a flowchart. The participant answers questions then the system shows an explanation. These flowcharts are constructed by consultants from old cases.

If the client are not satisfied the result of the

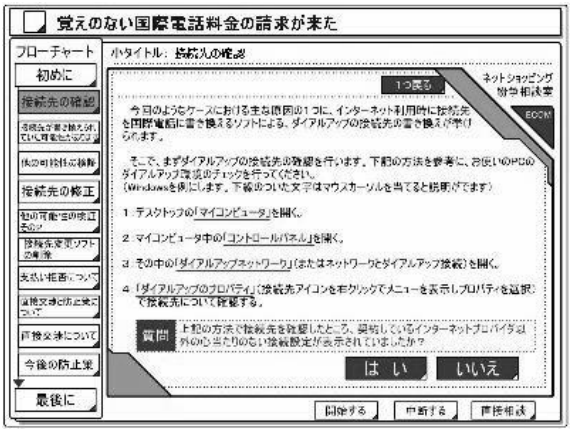

Fig. 2: Flowchart

Fig. 3: Screenshot of AMAS

flowchart, the process goes into phase Two. The client consults with a consultant by exchanging emails. In the most cases, ADRs finish in this phase.

If the clients aren't still satisfied, the ADR goes into phase Three. The consultant sends an email to the opposite person, and if he agrees, the mediation process starts. The system provides a negotiation table that enables an agent to mediate between two parties via a network. Fig.1 shows an overview of phase Three of AMAS. Two participants dispute through a computer network by exchanging proposals, opinions, or assertions, with facial expressions each other. A consultant (mediator) moderates the dispute between two participants. The mediator also makes some mediation proposals and sends them.

Fig.3 shows a screenshot of an interface for the participant of phase Three. AMAS system shows the proposals, opinions, assertions and facial expressions of the participants on the screen. The mediator controls the facial expression of the animated agent in the center, the opponent controls the right one, and the participant controls the left one. The participant decides the next proposal and the next facial expressions, and sends them to the opponent.

In the mediation, at first, the participants send arguments and demands each other. And the mediator checks whether the participant's response is suitable or not, using negotiation rules. The mediation is performed based on the arguments and demands submitted by both participants. Secondly, the mediator sends the mediation proposal. The mediation will be finished when both of participants agree the mediation proposal.

Besides above mediation process, the participants can use the participant agent which assists them. The participant agent sends proposals and facial expressions to the opponent. By using the participant agent, the participant can reduce a cost of dispute.

3. A Participant Agent

3.1 Architecture of a Participant Agent

The participant agent supports the participant in mediation. The participant agent has three functions. The first is to generate the unintentional facial expressions automatically. The intentional facial expressions are controlled by a participant directly. The second is to provide the participant with similar old cases. The third is to make proposals by following the participant's instruction.

- Unintentional and Intentional Facial Expression

  The agent generates the unintentional facial expressions based on the emotional model, automatically. In order to generate them, the agent learns the user's pattern of the unintentional facial expressions. And the user selects an intentional facial expression when the user sends the next proposal.

- Provide Information

  The participant agent provides the participant with information from similar old cases. This agent searches the similar old case which has the same features of current argument.

- Make a Mediation Proposal

  The participant agent makes some mediation proposals from similar old cases. The participant selects and edits a proposal from the proposals that the participant agent makes.

3.2 Modules

Fig.4 shows an architecture of a participant agent. The participant agent consists of Message Management Module, User Interface, Similar Case Retrieval Module, Evaluation Function Module and TAA module. We describe each module in detail.

- Message Management Module

  This module exchanges messages (a proposal and facial expressions) between an opponent and this agent. When a proposal and facial expressions

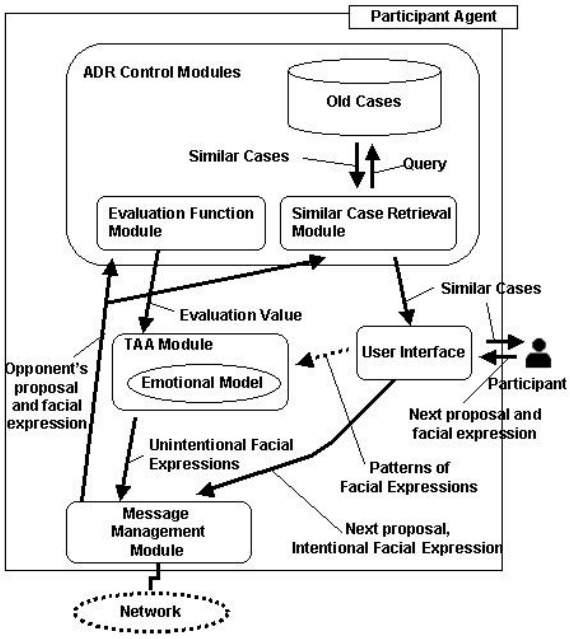

Fig. 4: Overview of Participant Agent

come from the opponent, this module sends to Similar Case Retrieval Module and Evaluation Function Module. And this module sends a message from the user to the opponent.

- Similar Case Retrieval Module

  When this module gets the opponent's proposal and facial expression, this module searches similar cases in old cases database, then shows the candidates of proposal from the result of search to the participant. This module searches the cases which are similar to current dispute in old cases database. All cases have some features about detail of the dispute. We analyzed the old cases and selected some key features. These key features are used as an index of each case. This module judges that two cases which have the same features are similar cases.

- User Interface

  The participant connects an AMAS server via the Internet with this module. And the participant inputs his/her proposal and facial expression by using this module. This module displays the opponent's agent and shows the proposal and facial expressions of the opponent. When the participant inputs proposal, this module shows candidates of proposal selected by Similar Case Retrieval Module. The participant can select and edit this candidate as the next proposal.

- Evaluation Function Module

  This module receives the message from Message Management Module, and outputs a subjective value as a number from -1 to 1 of the proposal. The evaluation value is sent to TAA Module

- TAA Module

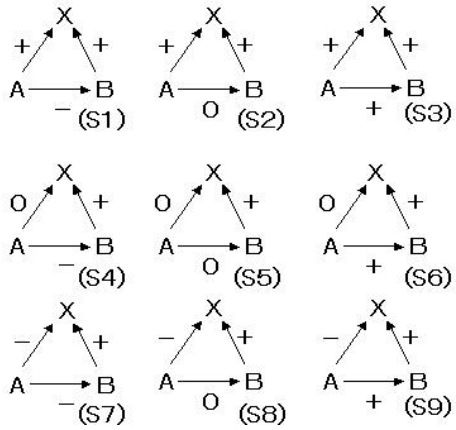

Fig. 5: Emotional States for B

TAA has two modes, a learning mode and an automatic mode. In the learning mode, TAA learns the user's tendency of selecting the unintentional facial expression, and constructs the user's emotional model. In the automatic mode, TAA works as a part of an agent and generates the unintentional facial expression instead of the user based on user's Emotional Model.

4. Emotional Model in TAA

In this section, we describe an emotional model to select an unintentional facial expression.

4.1 ABX Model

The emotional model in TAA is based on Newcomb's ABX model[2](Fig.5). The ABX model describes emotional states among two participants and one proposal. The relation among two of these entities is indicated by a plus sign, minus sign, or 0. The plus sign means a person has a positive feeling. The minus sign means a person has a negative feeling. The 0 means intermediate state.

In this model, each state is categorized into unbalanced states and balanced states. If one person has both positive relation for one entity and negative relation for another entity, then the state is unbalanced. Otherwise, the state is balanced. The unbalanced states are unstable and tend to move to the balanced states.

In the case of negotiation, we regards A and B as participants, and X as a current proposal. And we view arrows from participants to X as evaluation values of a proposal by participants[3, 4].

During the negotiation, when a participant receives a proposal from the opponent, the state transition occurs. When a participant A offers a proposal X, A must like X. Therefore, just after A receives B's proposal X, A and B's emotional state must be one of 9 states of Fig.5. The state (S1) and state (S9) are unbalanced states and the other balanced states.

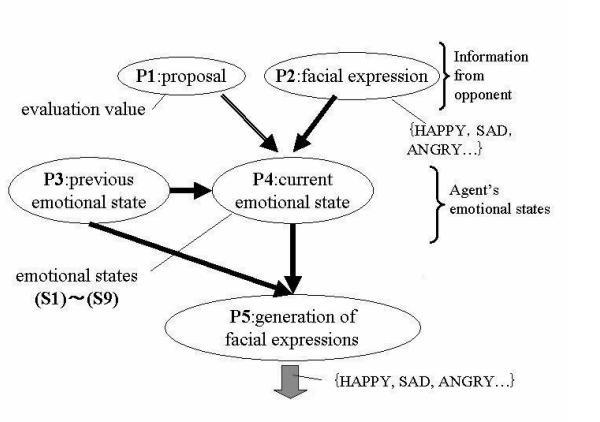

Fig. 6: Generation of Facial Expressions by Bayesian Network

Fig. 7: Tool for Price Negotiation

4.2 Generation of Facial Expressions Using Bayesian Network

We assume that the participant's emotional state transits from one state to another state with some probability, when the participant receives a new proposal and a facial expression. And one of unintentional facial expressions is generated with some probability, when the transition occurs. We use Bayesian Network in order to learn the probabilistic relations (Fig.6). The network shows that the transition from a previous emotional state (P3) to a current emotional state (P4) when the user receives a new proposal (P1) and a facial expression (P2). And a facial expression is generated when the transition from P3 to P4 occurs (P5).

These probabilities depend on a personality of a human. An emotional model is defined as probabilities of state transitions and generating unintentional facial expressions. To construct the emotional model, TAA needs to learn these probabilities from a participant.

4.3 Learning Emotional Model

We carried out the experiment of learning the emotional model in TAA. At first, we acquired probabilities by observing users' selections in an experiment using price negotiation. Next, we compared a selection of the users' and that of TAA.

The interface of learning is shown in Fig.7. This shows an operating panel and facial expressions of an opponent on the screen. The user selects a proposal

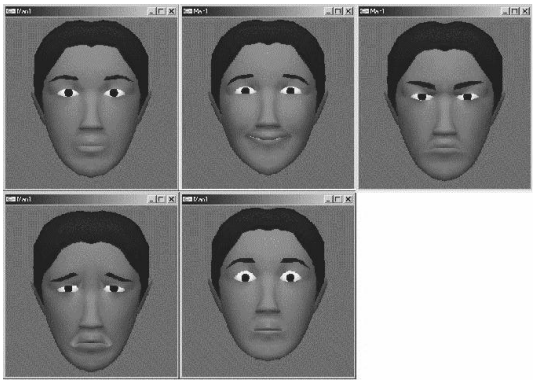

Fig. 8: Facial Expressions

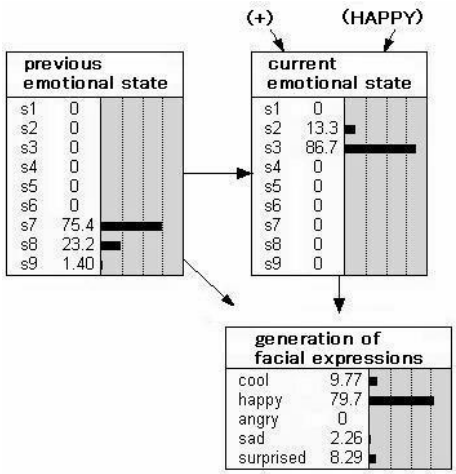

Fig. 9: The case of Proposal(+) and Facial Expression(HAPPY)

and an unintentional facial expression in the panel and they are sent from the user to the opponent in turn. Fig.8 shows facial expressions that the user can select (i.e., COOL, ANGRY, HAPPY, SAD, SURPRISED). We used MFACE[5] to display facial expressions. In this negotiation, users play a role of buyer and a program plays a role of seller, but users don't know whether the seller is human or not. And users must input an evaluation (+, 0, or -) of a feeling against the opponent on the panel.

Eleven students conducted the negotiation game. And Fig.9 shows a sample result after the tool learned the probabilities of transitions among emotional states and generations. Probabilities in Fig.9 means existence probabilities of the each states and facial expressions. We used a Bayesian Network Tool "Netica" to calculate existence probabilities[6].

The upper right part of Fig.9 shows the existence probabilities of 'current emotional states' when the user received the proposal(+) and the facial expressions(HAPPY), at the state was 'previous emotional states'. And the lower part shows the existence probabilities of facial expressions at that time. In that case, the probability of S3 has a 86.7% and the probability of HAPPY has a 79.7%. This means that when the

Table 3: Example of Similar Cases

Case	Proposal	Context
Current	Opponent's proposal	I'd like to [f31]return the [f3]old doll. I found that the left hand [f21]broke down. I think that this is a [f24]defective product. [f25]The doll's photograph in the auction site is not clear. [f25]You didn't explain that. Please give me a [f33]refund.
Case1	Opponent's proposal	I want to [f31]return the note PC for a full [f33]refund. [f24]It doesn't work. It's a [f24]defective product. I found that there was something wrong with the battery. You should have show the flaw.
	Counter proposal	I can't accept the [f31]return. I think that you should buy the battery. The battery is a only part of PC and you can [f5]exchange it with new one.

Table 1: Accordance of Model's Selection and User's Selection for Facial Expressions

A-A	B-B	A-B	B-A
73.0 %	68.5 %	48.8 %	19.4%

Table 2: List of Key Features

Topic - Internet auction trouble		
Category	Content	Code
Item	Mass-produced item	f1
	Rare item	f2
	Used item	f3
	Expensive item	f4
	Item with exchangeable parts	f5
Case	Breakdown	f21
	Need repair	f22
	Scratch	f23
	Defect	f24
	Improper explanation	f25
	Don't send item	f26
	Don't pay money	f27
	Inputting error of auction price	f28
Requirement	Return	f31
	Refund	f33
	Repair	f34
	Apology	f35
	Return auction charge	f36

user receives a good proposal and good facial expressions, the state tends to transit a better one, and the user selected the HAPPY in many time. As above, our emotional model is a good model which can consider the feelings for the opponent and the transitions of the emotional states.

Next, we show the effects of learning by the following experiment. In this experiment, we selected two students, A and B. At first, we constructed two emotional models, which are gained by both students' negotiation. Then both students continued the negotiation, and we compared facial expressions which both students selected with what selected automatically using these models.

Table 1 shows the result. In this table, 'A-B' means that we compared the TAA's selection with B's selection, after TAA learned the pattern of A. TAA matched the A's selection by 73.0% when TAA learned the pattern of the A. In the same way, it matched the user's selection by 68.5% in case of B-B. However, in case of B-A, it matched by 48.8% and in case of A-B, it matched by only 19.4%. These result shows TAA learns the user's pattern for each individuals and generates the unintentional facial expression appropriately.

5. An Example of Searching Similar Cases

In argument, it is important to know which subject the participants should talk about. We made a list of key features, which shows what the participants should argue. Table 2 shows a part of the list of key features, which are extracted from Internet auction cases. Based on the list, we can know the contentions of the proposal.

We define that a similar case is a case which includes same contentions of a proposal. The participant agent searches the similar cases, based on the kind of contentions in the proposal. When the agent finds the similar case, it shows the proposal and the counter proposal of the case. Table 3 is an example of found cases. This table shows the case when the opponent claimed that the opponent's product had a problem. In this example, the opponent's utterance includes [f31]return, [f3]used, [f21]broke down, [f24]defective product, [f25]explain, [f33]refund.

The agent searches the similar case by using these contentions. There are similar cases, Case1, in the table. And by using the similar cases, the participant can compose the counter proposal "exchange the part of doll with new one.", based on the utterance of [f5]exchange

in the example counter proposal. The participant edits the next proposal and sends it.

6. Conclusion

We introduced an online ADR system and the participant agent. The agent helps the participants by showing the similar old cases. The agent also uses facial expressions of an animated agent to dispute with the opponent in real time. It generates facial expressions based on the emotional model of the participant.

In the future, we will use this agent for another systems. We will apply the agent to a moot court support system of law education.

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