

# ***AniMed\**: An Automated Animated Mediator for Facilitating Negotiation with People**

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**Abstract.** Mediation is an important paradigm for dispute resolution which dates back to Ancient Greece. The goal is to reach an agreement, i.e. a mutually accepted solution, without resorting to a struggle. Yet, when people negotiate they demonstrate bounded rationality in their actions and diversity in their behaviors. This increases the difficulty to design automated mediators. To be successful, the mediator must take this into account and propose solutions deemed relevant, otherwise it will lose the focus and trust of the negotiators. We introduce *AniMed\** – an automated vivid animated mediator, incorporated with a novel proposal generation strategy, aimed to increase the social benefit of the negotiating parties. We will display the negotiation system and allow people to interact “face-to-face” with the automated mediator on various domains.

## **1 Introduction**

Mediation, which is the involvement of a third party in the negotiation process, can assist the negotiating parties in reaching beneficial solutions and increasing their social welfare. In many situations, the mediator does not have the authority to impose a solution on the parties or the power to compel them to uphold the agreement reached (unlike arbitration). Usually the mediator is neutral (unbiased) and objective.

Automated mediators, intelligent agents that take the role of an active mediator in the negotiation process, can play an important role in bridging the gap between people as they negotiate. They offer a discrete, impartial facilitator that might be more trusted than a human one. The computational resources of automated mediators may also be more useful when incomplete information exists and there is uncertainty regarding the preferences of the parties, as the difficulty for a human mediator only increases. Yet the use of automated mediators is far from widespread, perhaps due to the difficulties in bridging between people, or due to their computerized nature.

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\* This research is based upon work supported in part by the U.S. Army Research Laboratory and the U.S. Army Research Office under grant number W911NF-08-1-0144 and under NSF grant 0705587.

## 2 Related Work

Mediator agents can be used in many settings. For example, they can be used to solve distributed constraint satisfaction problems (e.g., [9]) or as self-interested shopping agents [10]. However, not many have focused on automated mediators in human-human negotiations. Some are discussed in the context of online dispute resolutions, which are mostly alternative services to litigation. For example, eBay's resolution center<sup>3</sup> tries to facilitate the resolution of conflicts between buyers and sellers.

A number of negotiation support systems are also described in the literature. Family Winner [1], for example, is system that assists divorcees to rationally negotiate their disputes. It does this by advising rational options for trade-offs of assets between opposing parties. However, it is focused on a single domain making it hard to be generalized. SmartSettle [12] acts as a support system that networks multiple parties located anywhere in the world and manages their confidential information with a neutral Internet site. Unlike the Family Winner and SmartSettle, *AniMed\** is a fully automated mediator.

The HERMES system [6] is a collaborative decision support system that acts as an assistant and advisor by facilitating communication and recommending solutions to members of a decision makers group aiming at reaching a decision. It uses an argumentation framework that provides an issue-based discussion forum [5] whereby users can propose and discuss alternative solutions. Like HERMES, *AniMed\** uses the issue-based discussion approach, yet *AniMed\** is implemented to support face-to-face negotiation, and not as a collaborative decision support system.

PERSUADER [11] is a computer program that acts as an automated labor mediator in hypothetical negotiations relying on Case-Based Reasoning methods. PERSUADER is topic-embedded, and requires data from previous negotiation sessions to reason. In addition, it employs manipulation methods as a mean of manipulating the parties. In contrast, *AniMed\** enables the parties to reach satisfactory solutions without the need to resort to manipulations and without the need of a historic database. In addition, unlike PERSUADER, *AniMed\** was evaluated with people.

e-Alliance [2] is an automated mediator that offers support for multi-issue, multi-participant (different partners can be involved) and multiple-cycle (cycles of proposals and counter-proposals over the same set of attributes) negotiations. These characteristics make the facility flexible enough for use in different domains. While e-Alliance was developed for agent-agent interactions, we are interested in the problem of human-human interactions.

*AutoMed* [3] is an automated mediator that most resembles our proposed mediator. *AutoMed* monitors the exchange of offers and actively suggests possible solutions. It uses a qualitative model for the negotiator's preferences, without past knowledge. The suggestions it makes are Pareto-optimal according to its estimations. *AutoMed* was evaluated with human negotiators who negotiated using a computer system by exchanging offers selected from drop-down lists. *AutoMed* participates as a third-party that sends suggestions via the system. However, *AutoMed* has its limitations. Mainly it does not suggest incremental (partial) solutions nor does it provide explanations for its suggestions. Moreover, *AutoMed* constrains the negotiators to negotiate through the system,

<sup>3</sup> <http://resolutioncenter.ebay.com/>

while a more natural approach would be to negotiate face-to-face. These drawbacks are nonexistent in *AniMed\**, allowing it to generate more satisfactory solutions that are deemed more relevant by the negotiating parties.

The incorporation of an animated avatar is also supported by Yee *et al.* [13] who have investigated the impact of avatars on user experiences. They showed that using visualization leads to better interactions with people. Our experiments have indeed shown the different outcomes when an animated mediator was used compared to others.

### 3 Mediator Design

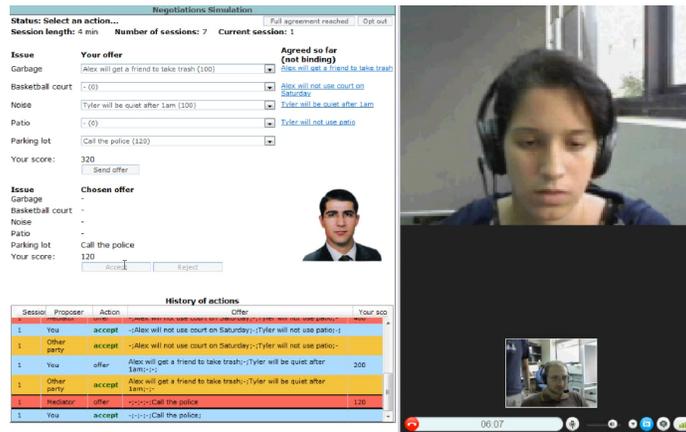
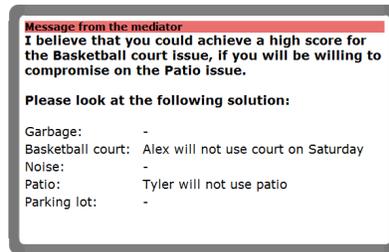


Fig. 1. An example of a negotiation interface.

*AniMed\** is a domain-independent automated vivid and animated mediator designed to improve the social welfare of *people* in bilateral negotiations. *AniMed\**, an English speaking avatar, interacts with people who negotiate face-to-face by means of a video-conference. *AniMed\**'s novel design allows it to propose solutions that are in the context of the current negotiation state. To achieve this, *AniMed\** utilizes recent solutions proposed by the negotiators when generating its own solutions, thus centering its solutions on the current context of the negotiation. This strategy differentiates it from other automated mediators found in the literature [3]. *AniMed\** also has the capability of proposing partial solutions, and by doing so it provides the negotiators with the option to incrementally strive for a beneficial solution. Moreover, the strategy incorporated in *AniMed\** does not rely on the utility function of both negotiators, but rather constructs a preference relation between the possible solutions. Thus, *AniMed\** has a generic strategy mechanism, allowing it to be matched and mediate proficiently with many possible types of negotiators without any restriction to any specific domain. In addition, *AniMed\** was supplied with a facilitation mechanism that provided the negotiators a “negotiation calculator” which enabled them to calculate the utilities of each solution at any given time. Lastly, as *AniMed\** was built on top of GENIUS<sup>4</sup>, a generic negotiation framework [8], it will be available for the public and can be modified and used in numerous domains.

<sup>4</sup> <http://mmi.tudelft.nl/negotiation/index.php/Genius>

Another consideration implemented in *AniMed\** is a simple argumentation mechanism to try to convince the parties why the proposed solution suggested by *AniMed\** should be considered. When *AniMed\** proposes a solution it attaches a predefined text message stating that if the negotiators make the suggested trade-off based on the issues previously discussed, they can achieve higher scores (the text is slightly different if the suggested solution includes issues that were previously agreed upon by the parties or simply discussed). An additional approach incorporated in *AniMed\** relates to its presence during negotiations. In order to compel people to listen to the mediator’s proposals, whenever it proposes a solution, it takes over the entire screen so people cannot conceal or ignore it. Moreover, the mediator was implemented as an English speaking avatar (translation to native language was given in the text) (see Figure 2), using a commercial text-to-speech engine in order to convey a more “humanized” appearance and a less distant and computerized one.



**Fig. 2.** *AniMed\** avatar example.

The human negotiators access the negotiation interface via a web address. The negotiation itself is conducted as follows: using a video conference the two players negotiate face-to-face about the different relevant issues. Since the focus of the research was on the strategy of the automated mediator, natural language processing (NLP) was beyond the scope of our research, and thus we currently require the negotiators to submit their proposals also using the negotiation system (this might also resemble real life negotiations in which people talk and only propose official solutions once in a while). This allows the information to be processed by the automated mediator. Nonetheless, the negotiation itself is not constrained and is employed via a face-to-face video conference. The acceptance or decline of each solution is also done via the user interface. The mediator sends proposed solutions to the parties via the animated avatar and the negotiation system.

*AniMed\** was evaluated in experiments with 130 people who negotiated face-to-face [7] on a neighbor dispute domain [4] by means of video-conferences. The negotiation

involved uncertainty with respect to the utility values of opposing parties, that is the exact utility of each negotiator was private knowledge. This uncertainty was also partially shared by the mediator, that had information solely on the preference relation between the issues and values under negotiation. *AniMed\** significantly increased the individual utility score and the social welfare, measured by the sum of utilities, of both negotiators, compared to experiments with other automated mediators or no mediator were involved. The results also indicate that while people are content with the solutions they achieve without any mediator involved, better solutions can be achieved when *AniMed\** is present, which only emphasizes the benefits of using it in human-to-human negotiations.

## 4 Demonstration

In the demo people will have the opportunity to negotiate with each other, face-to-face, while having *AniMed\** assist them during the negotiation. The negotiation system will be available both in English and in Turkish, and several domains will be available for the negotiation process. The interface is shown in Figure 1 and a sample snapshot of the mediation is shown in Figure 2. The success of the negotiators will be based on the quality of the agreement they were able to reach.

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