

Do You Follow Angel Agent's Advice?

A Pilot Study for Decision Making Support by Multiple Animated Agents

Masahide Yuasa and Daiki Morimoto
Department of Applied Computer Science
Shonan Institute of Technology
Fujisawa, Kanagawa, Japan

Abstract—With the increased use of information technologies, the importance of information services that assist us in one's daily decision-making has also increased. However, this is not enough to help in all our daily choices. When conditions are conflicting or complex, it is difficult to make appropriate decisions. In the case of conflict situation of decision-making, several films, television or manga shows often depict internal conflict by showing an angel and a demon characters that offer competing recommendations. The expression of two different characters may be used in the decision-making tool by using two types of animated agents that can induce suitable decision-making. Therefore, we proposed the decision support animated agents of angel and demon. In this study, we developed animated agents of both the angel and the demon that expressed their roles and promoted suitable decision making. The angel and demon agents responded against the user's utterance. The user may understand both for and against aspects in a conflict situation and then the make better decisions. We conducted two experiments: one using utility function without animated agent and the second one using only animated agent. The experimental results showed that when the angel and demon agents were used, the participant selected good choice. This is a useful way to use multiple characters with different characteristics in conversation.

Keywords—*animated agent; character; mood engineering*

I. INTRODUCTION

With the spread of Internet and increased use of information technologies, information services have become important as they assist us in our daily decision-makings, such as in the choice of dinner, clothes, and works. For example, the restaurant guide helps people find the best restaurant according to their desired requirements [1, 2]; the fashion site provides fashion advice that fits the customer's characteristics; and the weather forecast site helps people to decide whether they should carry an umbrella.

However, these are not enough to help in all our daily choices. New technologies, such as e-mail and smartphones, exacerbate multi-tasking [3] and increase the scenes of decision-making. Supporting decision making has been crucial in archiving many sorts of multi-tasking; however, in complex and conflicting conditions, it would be difficult to make appropriate decisions.

Traditionally, this difficult situation of decision-making has often been depicted by several films, television or manga shows as a whispering angel perched near one's ear and a

demon at the other ear, offering competing recommendations [4]. These characters express conflict dilemma; the angel says what one should do, and the demon implies what one wants to do. This expression of using two different kinds of characters can be applied to decision-making support tool by using two types of animated agents that induce suitable decision-making for the user.

Therefore, we proposed the decision support animated agents to use the metaphor of angel and demon. In contrast to the conventional decision-making tools, a user will be able to sort out the conflict by interaction with the angel and demon agents who play the role of advocates. In this study, we developed both angel and demon agents that expressed their roles. The angel and demon agents responded against the user's utterance. The users may be able to understand both sides of opinions and can compare the two types of advices sufficiently to make appropriate decisions. Moreover, the final decisions will be convinced for the user, and the method may also be effective in producing a suitable decision. In addition, it will be useful to use multiple characters that have different characteristics in interaction [5].

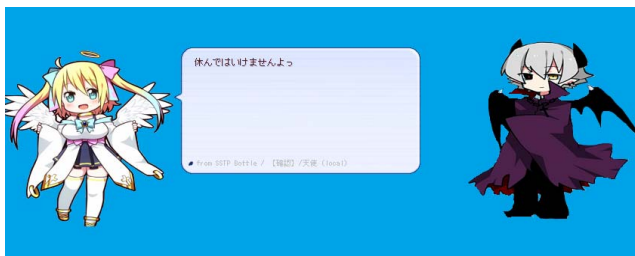
In the next section, we describe the overview of our proposed system, and in the third section, we explain the experiment performed to confirm the effectiveness of our proposed system. Furthermore, we also describe the discussion and the conclusion.

II. OVERVIEW OF THE PROPOSED SYSTEM

A. Developing Animated Agents of Angel and Demon

To develop the angel and demon animated agents, we used SSP (Sakura Script Player) [6], which can display an animated agent and control it on the PC screen. Multiple animated agents and their word balloons can be also displayed on the screen. Moreover, we used SSTP (Sakura Script Transfer Protocol), which is a mark-up script for SSP to control each agent's behaviors, such as movement of rip, blink, and postures. The agent can utter based on the prepared sentences, and the utterance control is also available by using mark-up description in SSP. For example, the mark "/i5" means executing an agent's animation pattern 5, and "/w9" is "waiting time (level 9)" between previous utterance and next utterance. Fig. 1 shows animated agents of angel and demon in this study. We drew images and patterns of both characters

and implemented them using SSP. The animations of these characters can be controlled by using SSTP.



(a) (b)



Fig. 1. (Top) Animated Agents of Angel (a) and Demon (b) (Bottom) Interface for Animated Agents.

B. Interaction between Agents and a User

In Fig. 1, the animated agents are shown at the top and on both sides of the PC screen. The agents' utterance in word balloon is also displayed, but this pilot system does not use the sound of utterance. The system has a microphone and receives a user's voice as responses against the agents' utterance, based on prepared utterance patterns autonomously. As we will discuss later, both agents can be controlled in a separate room by using SSTP, so that we make the participants believe them to be autonomous, even if the utterances are inputted by the experimenter.

III. EXPERIMENTS

To confirm the effectiveness of animated agents, we conducted two experiments; the first experiment is a conventional decision-making method using utility function without any animated agents, and the second one is an interactive experiment between agents and the participant.

A. Experiment using Utility Function as Conventional Decision-Making Method

For the experiment, we asked the participants to imagine a situation where they have to decide whether to go to the university or not when it is raining outside. The participants are showed the description "Do you go to university, although

it is raining outside now?" However, this setting is very simple and cannot make the participants image conflicting situations. Therefore, we requested the volunteers to collect details on conflict situations through discussions. Consequently, additional conditions were; "first lecture of the day," "the last part of November," "The attendance point is a little over the borderline" "Tardiness will not be tolerated in the lecture (lose the attendance point)," "It takes 5 minutes from home to station." By using these conditions, we enabled a participant to believe that a conflict situation requires a choice of one of the two alternatives. Moreover, in this experiment, we used the conventional method of decision-making using the utility function. The participants are required to write down no more than five advantages and disadvantages in the sheet (Fig. 2). They were also asked to score the level of importance for each item such that the total score is no more than 100. After the participants had given their scores, the experimenter estimated the weighted average and judged whether a participant selected "should do" or "want to do." Fig 2. shows an example of descriptions and scores. In this case, the score of "should do" is 55 points and the score of "want to do" is 45 points, indicating that the participant should choose "should do"; thus he/she should attend the class.

Advantage (free descriptive answer)	Important Degree
Keep the attendance point	10
I don't need to go when I would be sick (Keep the attendance point)	20
Preparation of being a member of society	15
Can attend the class, can keep up with the classwork	10
55	
Disadvantage (free descriptive answer)	Important Degree
Loose the attendance point	10
I must go even if I would be sick (to keep the attendance point)	15
Can't keep up with the classwork	20
45	

Fig. 2. An example of descriptions and scores.

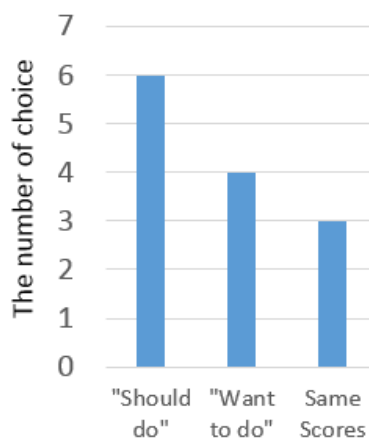


Fig. 3. The number of choice of "should do" or "want to do" (N=13)

B. Result in the Case of Utility Function

Fig. 3 shows that the results of the judgment using the utility function for 13 participants. As can be seen, there are six participants who should attend the class, four participants who should not attend the class, and three participants with the same scores. We will compare the results with the next experiment that uses animated agents.

C. Experiment with Animated Agents

To confirm the effect of animated agents, we prepared the same question and conditions (“Do you go to university, although it is raining outside now?”). Moreover, the angel agent and demon agent respond against the user’s utterances. The participants were instructed about the situation and that they were required to talk to the angel and the demon. In the experiment, we used the WOZ (Wizard-of-OZ) method [7]; the participants believed that the agents were autonomous. However, these were actually operated by the experimenter in a separate room. In this experiment, the participant’s voices are sent to the separated room, and both the agents can respond from the room using SSTP. The experimenter inputs the utterance or selects the sentence as a response; however, the experimenter does not induce a certain result, he/she infatuates the flow of conversation as evenly as possible. For example, when a user says “I don’t go to university,” the angel responds “Don’t cut the class...” On the other hand, when the participant says, “I will go to university, today,” the demon responds, “No problem, if you cut the class. You do not need to go to the school.”

For the experiment, we added one more topic similar to the topic about the previous one. After the angel or demon agents had given their advices, the participants were required to answer which advice they agree with.

D. Result in the Case of Animated Agents

The experiments involved 15 participants, including the 13 participants who attended the previous experiment using the utility function. Fig. 4 shows the answers after the angel agent or demon agent gave the first and second advices, respectively. In Fig. 4, the term “T1-1” means first topic and first advice. In the case of T1-1 and T2-2, all the participants answered that they agreed with the angel agent.

In the case of T1-2, only one participant chose the demon’s advice, and in the case of T2-1, six participants selected the demon’s advice. We conducted Binomial test for them, which showed a significant difference in the case of T1-2 ($p < 0.01$); however, there is no significant difference in the case of T2-1 ($p = 0.30$).

Fig. 5 shows the average values of total answers, indicating the advice chosen by the participants. We conducted a t-test for them with a significant level of $p < 0.01$, and so the case of selecting the demon is significantly low.

After both the experiments, the participants were required to answer which advice method (utility function or animated agents) was useful, on a scale of -3 (utility value) to $+3$ (agents). The average value was “ -0.33 ” ($N=15$), and the

participants preferred the utility function method than the animated agents.

IV. DISCUSSION

As described above, the first experiment revealed that there are more participants who should attend the class than the participants who need not attend and who had the same scores. On the other hand, in the second experiment, there were more participants who agreed with the angel than the participants who agreed with the demon who advised not to attend the class.

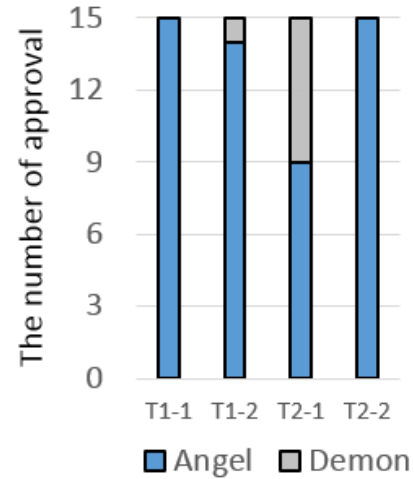


Fig. 4. The number of approval for angel or demon ($N=15$) “T1-1” means first topic and first advice of angel or demon agent.

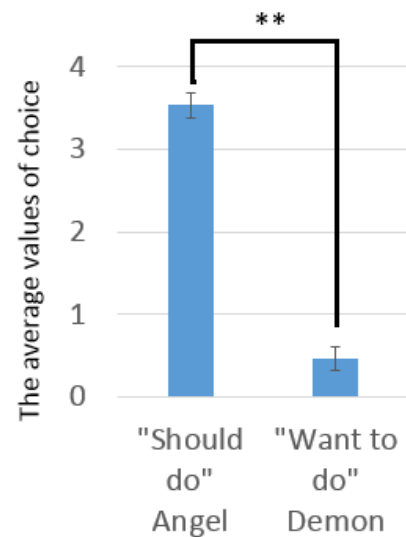


Fig. 5. Average values of choice of angel or demon ($N=15$, $** p < 0.01$)

It is interesting results that the more selections of “should do” (angel) than the case of using utility function, even though utility function may induce more cool judge. The animated agent may be able to induce calm judgment of the circumstances. In general, when people talk to someone about one's problems, they can sort out one's standpoint on the problem logically and calmly by talking with others. Even though the interaction system has only a non-human agent, the system may have a similar effect on humans.

In addition, these experimental results indicate that our system influenced the participant's decision-making, even though the adviser is an artificial animated angel and demon agent. Visualizing angel and demon may be useful for developing decision-making tool.

Furthermore, as shown in the last question after both the experiments, the participants preferred the utility function method. The reason they did not prefer the animated agents was investigated by free descriptions of the answer. The reasons were “the response is late” and “sometimes I was afraid that the system can recognize my voice, because there was time lag.” This is due to the WOZ method, which requires the participant to input sentences manually, which leads to a time lag. Future experiments should focus on improving the response time.

In the experiment using agents, we used the interaction among angel, demon, and participants. It may be need the experiment using only single character (only angel or demon). By conducting an experiment using a single character, the effectiveness of multiple characters can be confirmed. In addition, the difference feature of angel and demon should be considered [8, 9]. In this study, we prepared the features of angel and demon subjectively; however, we should take into account the features suitable for angel and demon. Moreover, we should focus on the difference of abstractness. Previous studies described the difference in effectiveness for each abstractness [9, 10]; therefore, the additional experiment by deference of features and abstractness should be conducted in the future to confirm the detailed effects of animated angel and demon agents.

In the usual TV programs and comics, both the angel and demon agents expressed their own opinions about the user's situation. However, in this system, both the angel and the demon responded to the user's utterance, without expressing their opinions. We focused on the interaction between the user and the agents who responded to the user. We intend to develop those agents who will express their opinions first and confirm the effect of the other settings.

Moreover, in our experiment, both agents gave advice twice on different conditions (the user does not want to go to university because of two reasons; “heavy rain” or “train delay”). We used the same topics for these two conditions, and the characters' talks were adjusted by the interview results of several volunteers. We thought that there were few differences; however, there is a possibility that the results will change for other topics and conditions. Thus, this requires additional experiments.

According to the order of the experiment, the tests of utility functions were carried out first, followed by that of the animated agents. In this experiment, since this order had a few impacts, we believe that the reverse order may have a more impacts because the user had received the character's advice before the test of utility functions. We will confirm the influence of the order or conduct an experiment in which the participants would be divided into some groups based on the order.

V. CONCLUSION

We proposed the decision support animated agents using the metaphor of angel and demon. We developed animated angel and demon agents demon that expressed their roles and promoted better decision making. We conducted the two experiments: one using utility function without any animated agents and second using only animated agents. The experimental results showed that when the angel and demon agents were used, the participants selected “should do” choice. In the future, multiple characters that have different characteristics can be useful in creating an interactive system or multiparty conversational system [5].

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