CHAPTER 3

Poker Game Design

This chapter describes the character design, interface design, and system design of the poker game, which is an experimental environment used to study the effect of personification of agents. Designing the facial representation of the poker playing agents was one of the most important parts of this study. The design of the experiments are described in the next chapter.

Why a Poker Game?

The way people play poker has two aspects: 1) mathematical probability and 2) psychology. In the first category, players concentrate mainly on their hands and how many cards are dealt to others. In the second category, players play against people they know and have some idea of their opponents' playing styles and use that information to help formulate betting strategies.

In this research, the poker game was chosen to observe to what extent subjects concentrate just on their hands, or pay attention to the faces of opponents and try to interpret their facial expressions. Since subjects do not know anything about the agent's playing style--risk-taker, aggressive, timid, calculating, etc.--at first, they cannot infer anything from looking at their faces or mannerisms which they can do in a real poker game. Do they get into a "psychological" mode after playing poker for a while against the same agents? Do subjects notice the meaning of facial expressions in a game where players should have "poker faces"?[1] The poker game interface was designed to support both modes. If users do not want to see the opponents' faces, they can just concentrate on the math. If they want to observe the faces, they can keep watching them while playing.

The poker game is written in Java to utilize the World Wide Web so that users participate in the experiment exactly the same was as they work in normal conditions. There is a need to conduct experiments on the web because of two reasons. One is that the nature of the experiment needs participants from various backgrounds and age ranges. The other is that current software agents are mostly used on the web.

Designing Characters

The purpose of the experiment is to understand 1) the effect of having a face in an interface, 2) what kind of facial features (gender, humanity, realism) make the agent look intelligent,

1. To examine the appropriateness of using a poker game for an experiment, a test experiment was conducted prior to the main experiment. See Chapter 4 for a detailed description.

likable, and comfortable to work with, and 3) the effect of using facial expressions. Thus, the representations for the agents are the important part of this study.

The poker playing agents used in the experiments have seven different graphical representations: Realistic Human faces, Caricature Human faces, a Caricature Dog's face, a line-drawn Smiley face, and the Invisible Man, which has no face (see Figure 6). Realistic images are taken from photographs of a male and a female face with ten facial expressions. Both faces have dark hair. Caricature Human faces were drawn based on the Realistic faces. The purpose for using the same faces for the Realistic images and the Caricatures is to keep the similar expression of the faces. Table 1 shows the categorization of the faces. Figure 6 shows the graphical representations of the poker playing agents.

TABLE 1. Facial features of the poker playing agents

HUMANITY	REALISM	GENDER
Human	Realistic	Male / Female
	Caricature	Male / Female
	Line-drawn Smiley	-
Non-Human (Dog)	Caricature	-

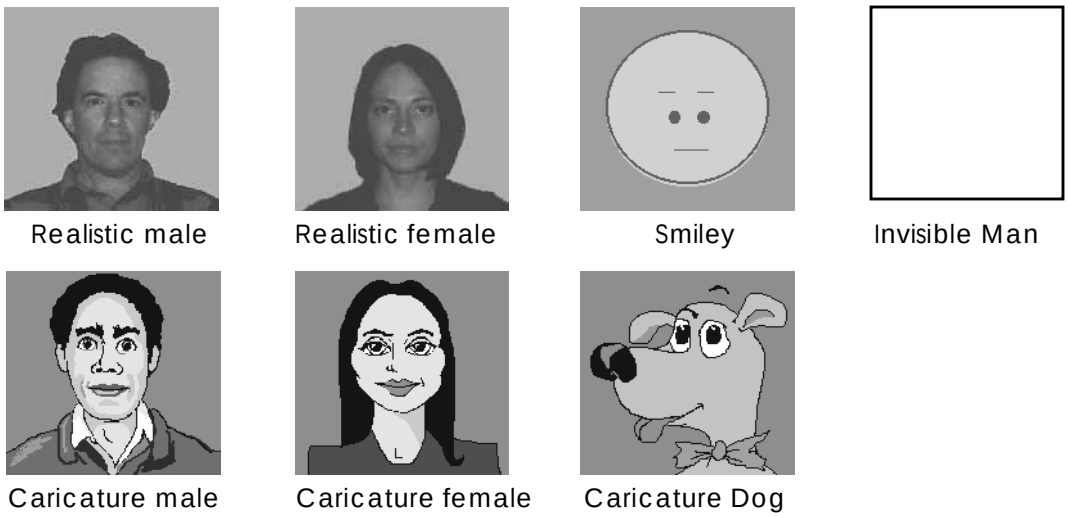

FIGURE 6. The graphical representations of the poker playing agents

Designing Facial Expressions

Each poker playing agent has ten facial expressions. They are neutral, pleased, displeased, satisfied, disappointed, surprised, relieved, excited, anxious, and very excited expressions. Figure 7 shows the ten facial expressions of the female Caricature face. The order of the expressions are the same as stated above. The facial expressions for each character were pre-tested to validate that they express the right emotions. Ten subjects were asked to make pairs of emotion types with the ten facial expressions. Ninety five percent of the answers were correct. Appendix 1 shows all character's facial expressions.

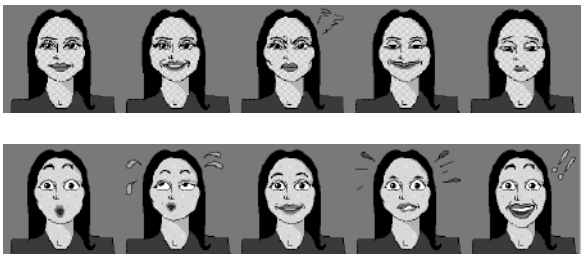

FIGURE 7. **Ten facial expressions of the female Caricature face**

Selecting Emotion Types -the OCC model-

The ten expressions are derived from the Ortony, Clore, and Collins (OCC) model of emotions [Ortony 88]. There are many approaches in defining and modeling emotions in psychology. Among them, the OCC model is designed as the basis for a computational system reasoning about emotions. The OCC model assumes that emotions are the result of valanced--positive or negative--reactions to situations which a person experiences. For example, when we compare the winning lottery number and the lottery we have, this event leads to a pleased emotion when we win, or a displeased emotion when we lose. In this model, the world consists of events, agents, and objects. Valanced reactions to combinations of these result in emotions. The model leads to different emotional states depending or whether the reaction is positive or negative (see Figure 8). A more complicated emotion structure exists for reaction to events and agents, and depending on whether the situation affects the self or someone else.

In the poker game situation, I assume that the world consists of events. To keep the model simple, reactions to other agents are not considered in the poker game. Thick arrows and gothic characters in Figure 8 show the modified structure of the emotion types used in designing the possible emotions for the poker playing agents. The modifications were made after interviewing two experienced poker players. When a poker playing agent sees its hand, that is an *event*, which leads to a valanced reaction of a **pleased** or **displeased** emotional state (see A in Figure 8 and Figure 9). Betting is an *event*, which focuses on the consequences for *self-prospects*. The betting event derives a valanced reaction of **hope** or **fear**, which is represented by an **excited** or **anxious** expression (see B in Figure 8 and Figure 9). The emotion intensifies as another betting round goes on, especially when the agent is bluffing. At the final stage, the agent shows a **satisfied** expression when it wins (*hope confirmed*), **disappointed** expression when it loses (*hope disconfirmed*), **relieved** expression when it folds (*fear disconfirmed*), or a **surprised** expression when the result is not what was expected (*unexpected*) (see C in Figure 8 and Figure 9). The OCC model does not include "surprise" in their emotion types. However, "surprise" is a common emotion in a real poker game environment.

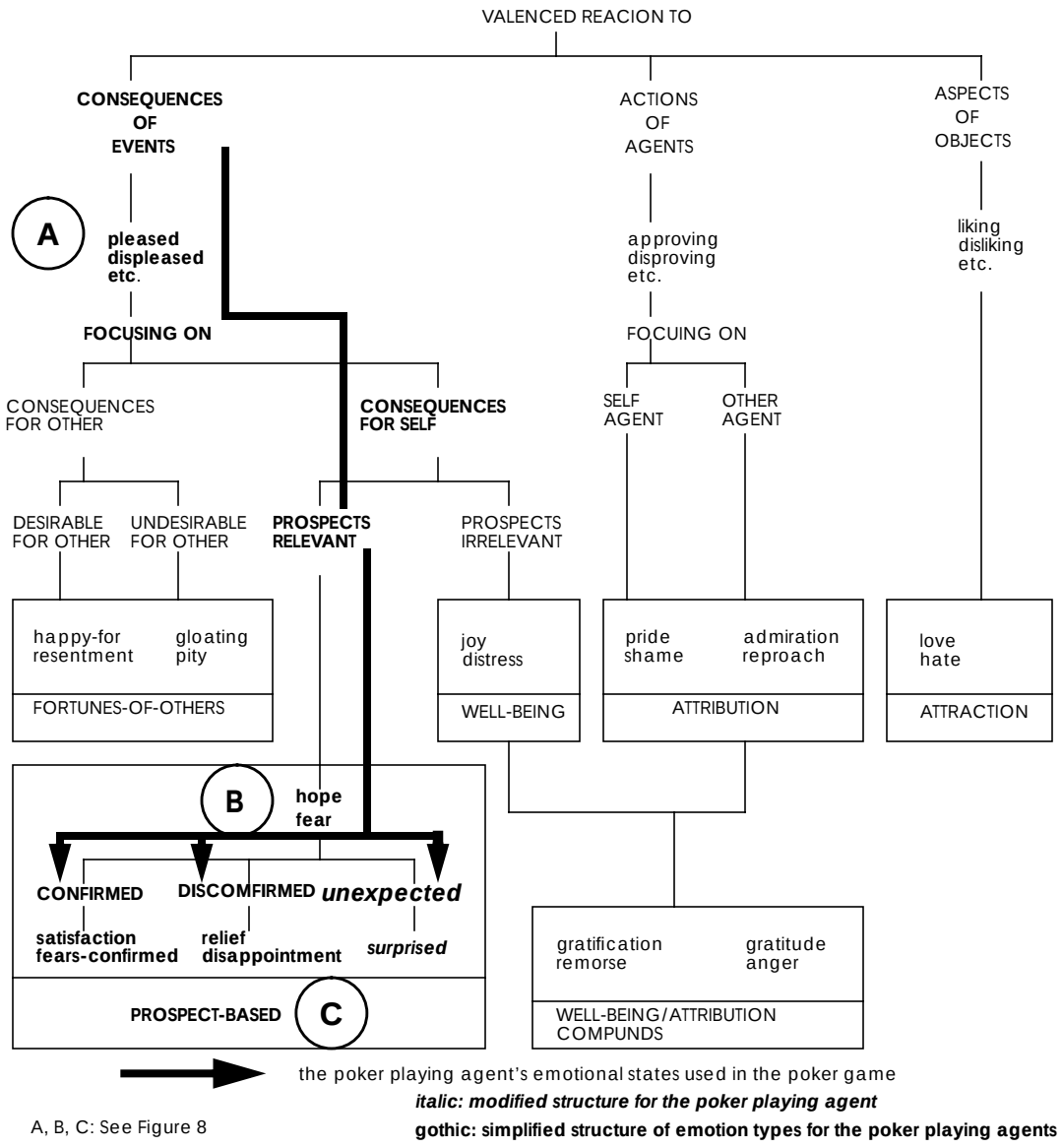

FIGURE 8. Global structure of emotion types in the OCC model adopted from [Ortony 88]

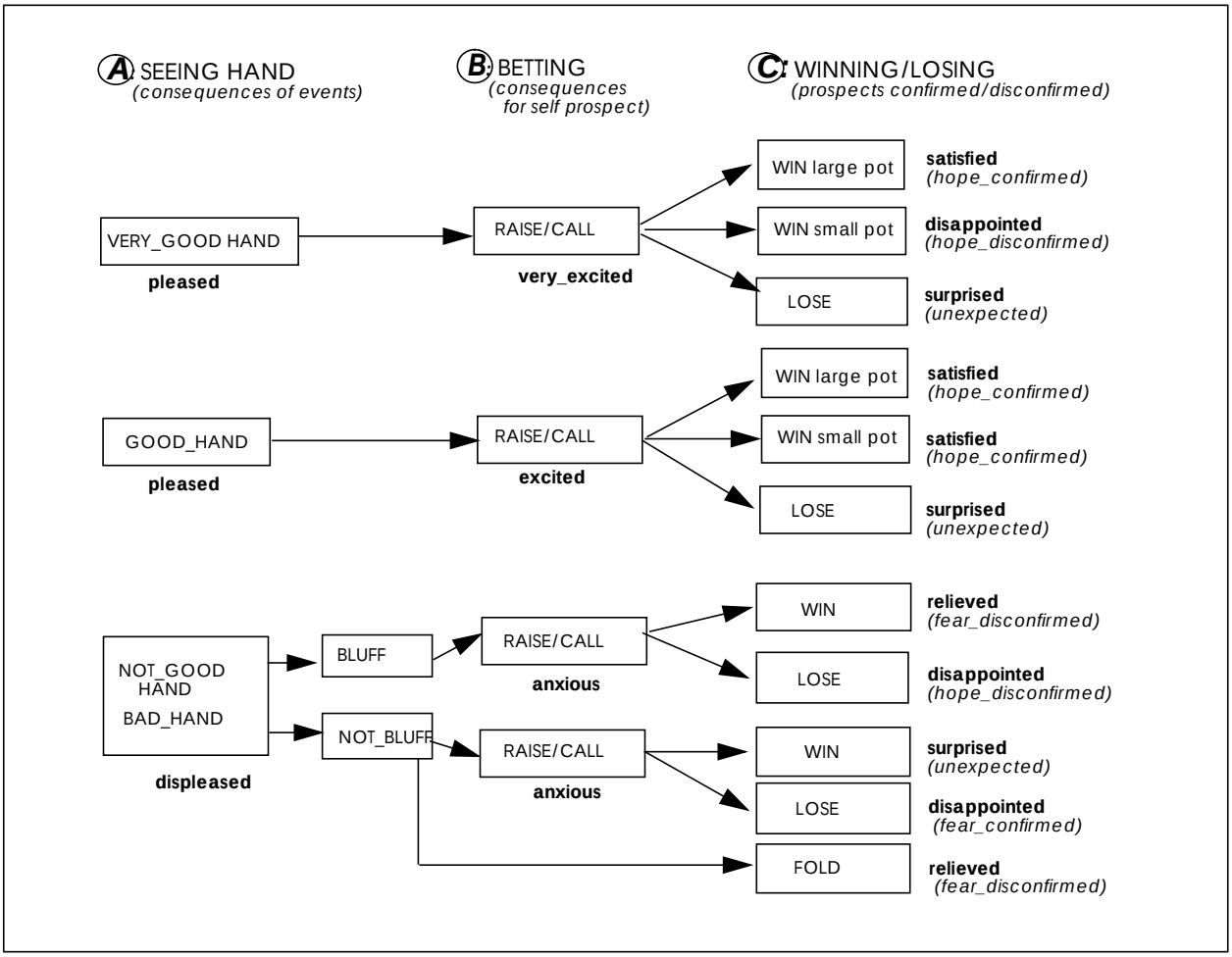

FIGURE 9. **The emotion types for the poker game**

Applying the Emotion Model to the Poker Game Environment

Emotional states of a poker playing agent are determined based on the situation it is in, as illustrated in Figure 9. After dealing or discarding and when the agent sees its hand (see the next section for the categorization of a hand), it has one of the following facial expressions:

- **Pleased** when its hand is “VERY_GOOD,” or “GOOD”.
- **Displeased** when its hand is “NOT_GOOD” or “BAD”.

While betting, the agent has one of the following expressions and intensifies the emotional level as another betting round goes on:

- **Very_Excited** when its hand is “VERY_GOOD” and it raises or calls.
- **Excited** when its hand is “GOOD” and it raises or calls.
- **Anxious** when its hand is “NOT_GOOD” or “BAD” and it raises or calls.

During the winning/losing stage, the player has one of the following expressions:

- **Satisfied** when its hand is “VERY_GOOD” or “GOOD” and wins large pot (*hope_confirmed*).
- **Satisfied** when its hand is “GOOD” and wins small pot (*hope_confirmed*).
- **Disappointed** when its hand is “VERY_GOOD” but nobody makes a big bet or folds (*hope_disconfirmed*).
- **Disappointed** when it is bluffing and it loses (*hope_disconfirmed*).
- **Disappointed** when it is not bluffing and it loses (*hope_disconfirmed*).

- **Surprised** when its hand is “VERY_GOOD” or “GOOD” but it loses (unexpected).
- **Surprised** when its hand is “NOT_GOOD” or “BAD” but it wins when it is not bluffing (unexpected).
- **Relieved** when its hand is “NOT_GOOD” or “BAD”, is bluffing, and wins (*fear_disconfirmed*).
- **Relieved** when its hand is “BAD” and it folds (*fear_disconfirmed*).

The later section (System Design, Poker Playing Strategy) describes the strategy in more detail.

Different Modes of Expressiveness

The poker playing agents have three different modes of expressiveness.

- The first one is the honest mode, in which a player is honest about its hand in its facial expressions.
- The second is the deceiving mode, in which a player is expressive, but its facial expressions do not correspond to its actual hand. A poker playing agent in deceiving mode shows one of the set of facial expressions in each stage described above. For example, the agent shows either pleased or displeased expression when dealing, regardless of its hand.
- The last mode is the stoic mode, in which a player has stoic expressions, a poker face, so to speak. The poker playing agents show only **neutral** and **pleased** expressions when they see their hands and bet in stoic mode.

Designing the Interface

The web interface of the poker game has a poker table surrounded by up to five poker players including the user (see Figure 10). The user is sitting in front of the table, and his/her hand and the amount of money is shown under the table. There is a message area in the center of the table. This area is used to instruct the user (i.e., “Please discard.”), to tell other player’s actions (i.e., “Bruce raises $10.”), and to tell the result (i.e., “Pattie won!”). The current pot is shown under the message area.

The poker game situation changes every second. In other words, users see their opponents make an action every second[1]. A new status message appears every second, and the agent who took action at that time changes its facial expression. The game stops when it waits for the user’s action, such as call, raise, or discard. There are interaction buttons at the bottom of the screen to let users play the poker game. They are “open”, “fold”, “discard”, “pass”, “raise”, “call”, continue”, and “questionnaire” (see APPENDIX 2 for instructions for playing the poker game and Chapter 4 for the questionnaires).

There were several user interface modifications after hearing test users’ opinions. One user worried about his hand “being peeked on” by other poker playing agents. The poker table was redesigned to make it look like 3D by tilting it and giving it some depth to solve this problem. Several users reported that it was easy to get lost in the game because they did not know when to play and where to start. To solve this problem, two modifications were made.

1. During the test experiment, different playing speeds were tested. Some subjects preferred slower speed to observe what other players were doing, while other subjects preferred playing faster and did not want to wait for their turn.One second was the appropriate speed in general. See Chapter 4 for the description of the test experiment.

The first modification was to change the color of messages to a user to blue, while status messages are shown in black. The second modification was to disable/enable buttons in each stage. For example, the “discard” button is clickable only when it is the user’s turn to discard. The third suggestion was to move status messages near each players, so that users do not have to move their eyes from the message area to each of the faces. However, the message position should be kept in the center, since the purpose of the experiment is to let the user choose which information they try to pay attention to, the messages and/or the faces.

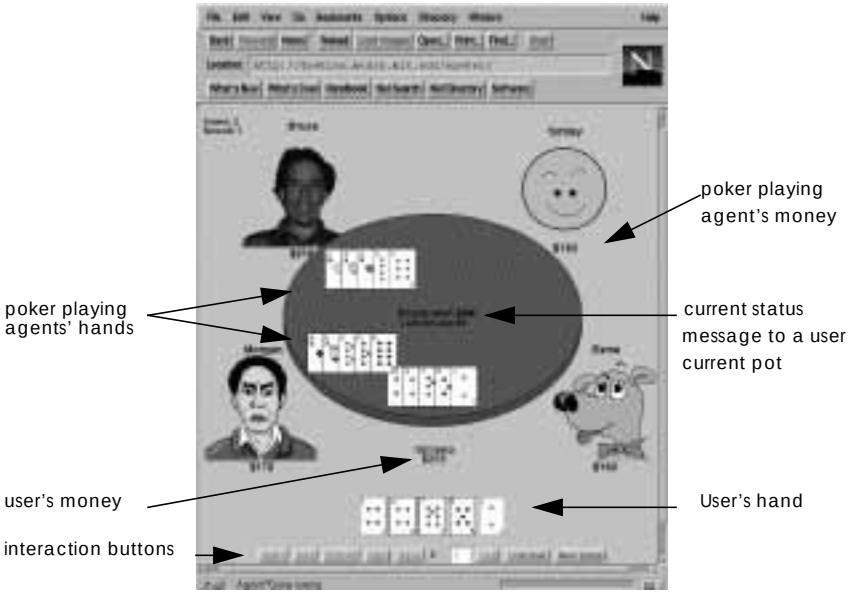

FIGURE 10. Web interface of the simulated poker table

System Design

Overall Architecture

Each user downloads the same poker java applet, which runs in the client's site independently from the poker server. The java applet contains the poker game and the facial images. The applet randomly assigns one of five experiments to users in an randomized order. A java application in the server continuously logs the players' hands, actions, and the amount of money that the player has in a disk while users are playing the poker game. After finishing one condition, the applet sends the experiment name and the user's name to the server, and then calls a CGI script which dynamically generates a corresponding questionnaire in HTML format. Another CGI script collects users' answers to a questionnaire in a server disk for future analysis. Another CGI script checks log files and generates a high-score list. Figure 11 shows the poker game system structure.

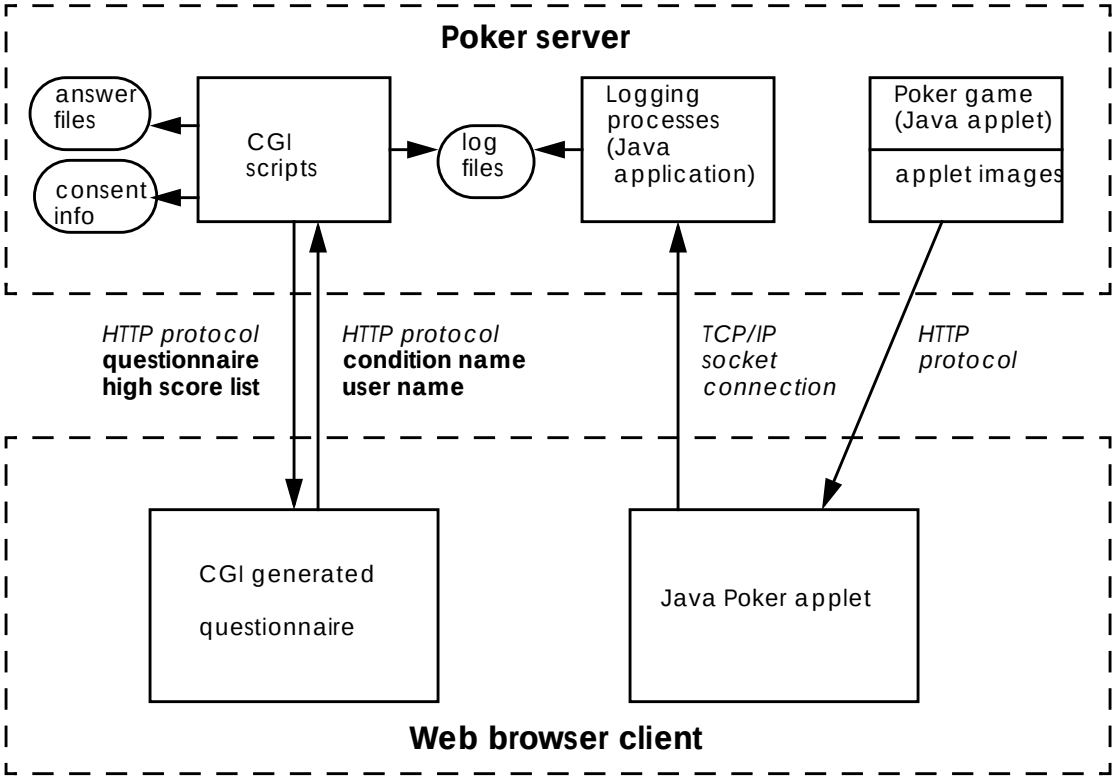

FIGURE 11. Poker game system structure

Poker Playing Strategy

The purpose of building the poker game was not to make the best or most realistic game available, but more importantly to make one with expressive poker playing agents. Thus, the implementation of the poker playing strategy is minimal. The player's hand is categorized as follows:

- “VERY_GOOD”: Straight flush, 4 of a kind, Full house, Flush, Straight, 3 of a kind
- “GOOD”: Two-pair, High-pair
- “NOT_GOOD”: Low-pair
- “BAD”: Nothing

The betting strategy is as follows:

There is a total raising limit (the pot should be under $150) in the poker game. When a poker playing agent has a “VERY_GOOD” hand, it raises up to a maximum raising limit ($30) per betting round when its hand is not new, or raises up to $20 when its hand is new. “Up to” means that the actual bet is determined by a random number within the limit, in order not to let users notice the playing style too easily. When it has a “GOOD” hand, the poker playing agent raises up to $20 when its hand is not new, calls when the money it has to pay to call (“dif”) is more than $20, or raises when “dif” is less than $20. When the agent has a “NOT_GOOD” hand or a “BAD” hand, it “decides” whether to bluff or not by a randomized procedure. It raises up to the maximum limit when it is bluffing, calls when “dif” is less than $5 or $10 and when not bluffing, or folds when “dif” is bigger than $5 or $10. Figure 12 shows the poker playing strategy described above. All the poker playing agents have the same strategy.

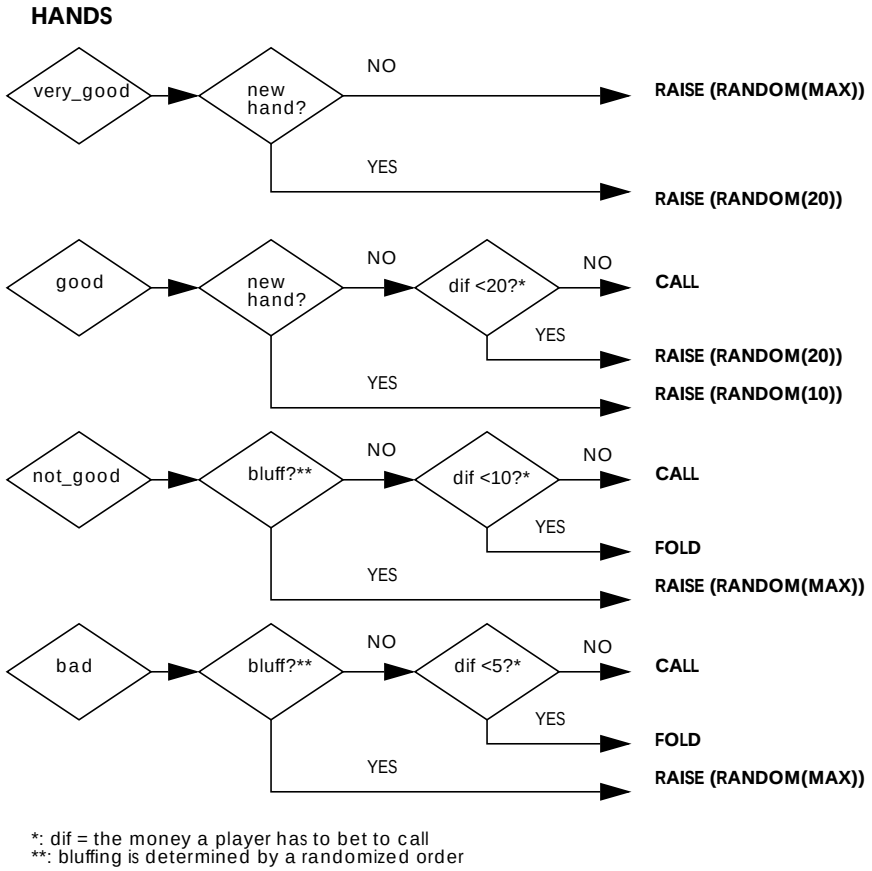

FIGURE 12. Betting strategy used in the poker game