Biofeedback Training with EmoPoker: Controlling Emotional Arousal for Better Poker Play

Tetsuo Yamabe[*†], Ilkka Kosunen[†], Inger Ekman[‡], Lassi A. Liikkanen[†], Kai Kuikkaniemi[†], Tatsuo Nakajima[*]
[*]Dept. of Computer Science, Waseda University, Japan
[†]Helsinki Institute for Information Technology, Finland
[‡]Center for Knowledge and Innovation Research, Aalto University, Finland
{yamabe, tatsuo}@dcl.info.waseda.ac.jp, {ilkka.kosunen, lassi.liikkanen, kai.kuikkaniemi}@hiit.fi, inger.ekman@hse.fi

ABSTRACT
A game of poker is a typical example of a situation involving *inperfect information*: players have to make decisions under uncertainty. This uncertainty can evoke emotional arousal and lead the player to make irrational decisions. In this paper, we introduce the EmoPoker system, which aims at making the player aware of the arousal level by providing biofeedback. With the EmoPoker system, we expect that a poker player becomes able to control their own arousal, consequently improving their gaming performance. EmoPoker presents itself as an augmented reality application, and its design is based on the traditional game concept. In this paper we also introduce other possible use cases of biofeedback training.

Categories and Subject Descriptors
H.1.2 [**Information Systems**]: User/Machine Systems – *Human factors*. H.5.2 [**Information Interfaces and Presentation**] User Interfaces – *Training, help, and documentation, Prototyping*, K.8.0 [**Personal Computing**]: General – *Games.*

General Terms
Design, Experimentation, Human Factors.

Keywords
Poker, biosignals, biofeedback, sonification, decision-making, emotional arousal , augmented traditional game environments.

1. INTRODUCTION
Poker is one of the most popular card games and it is often played for gambling. It maintains an element of chance because it is an imperfect information game: except for own hand cards, most of the cards are hidden from a player. A poker player needs to make decisions under uncertainty, such as changing cards, raising a bet and discarding a hand. Like other gambling games, this uncertainty can evoke the mixed feelings of excitement and anxiety. This makes poker play tightly linked with emotional arousal. For example, Kallinen *et al.* [4] examined psychophysiological responses to a poker game. They measured the level of arousal from SCL (skin conductance level), attention from HR (heart rate), and positive/negative emotion from facial EMG (electromyography) activity focusing especially on differences between specific events in Texas Hold'em poker (e.g., "All-in", "Fold", and "Win"). Their experimental results showed that specific game events elicited significant psychophysiological responses. For example, positive emotion, higher attention and higher arousal were observed after a player went All-in (i.e., bet all the money).

Beyond luck, poker requires skill. For instance, understanding probabilities and logical strategies facilitate effective poker play. However, as the common term "poker face" indicates, controlling one's own emotions is also an important skill. In addition to the information apparent on a table (e.g. discarded cards, amount of tips), the player's behavior can give clues as to the contents of his or her hand. Moreover, as learned from studies in behavioral psychology and behavior economics, emotional arousal increases the amount of irrational decision making [1]. This is a remarkable fact to consider when looking at gambling, since we also easily get emotionally excited in unpredictable economic activities [5]. Thus even if a player prepares a well-formulated strategy, the strategy might fail as the consequence of the emotions elicited by the game. Moreover, even when a poker player understands the importance of arousal control, it is difficult to objectively and calmly assess how aroused one is while playing. Especially novice players may have a hard time paying enough attention to their emotions, as their cognitive resources are occupied by the demands of the game strategy.

In this paper, we introduce the EmoPoker system. It aims at supporting conscious control of emotional arousal for better gameplay. Normally the player does not have a way to objectively observe and quantify arousal level. EmoPoker provides biofeedback as an easy-to-check indicator to recognize and understand a player's mental state. As a first step, we are developing auditory biofeedback that is dynamically controlled based on psychophysiological information. For example, heart rate is sonified by a heart beating sound through earphones, and several parameters of the tone (e.g., tempo, pitch and volume) are changed according to realtime HR data measured from the player. EmoPoker is designed to support rather a traditional game style than a digitalized video poker. Thus, in addition to the self-training purpose, players can also enjoy poker with other playful features.

2. SYSTEM DESIGN
As mentioned above, techniques inherent in human communication such as a bluff are important in poker play, as well as calculating the probability of winning hand. Therefore,

instead of targeting video poker, we referred to conventional tangible poker play.

Our system is designed as an *augmented traditional game environment* [2]-[3]. The traditional game augmentation aims at adding new value and playful features to the traditional game with keeping its original look-and-feel. For example, game objects (e.g., dealt cards in poker, and chessmen in chess) can be tracked by adding RFID (radio frequency identification) tags. An object tracking system also enables recording game events automatically so that players can review the gaming process, strategy and excited scenes after the game finishes. In this case, object monitoring is conducted automatically. Thus, players can concentrate on playing the game as usual. EmoPoker is also designed to be an instructional aide. Another merit of this approach is that the players can dynamically and seamlessly turn on and off the feedback support while gaming. It is desired that the self-training effect remains after removing the system support. Since the EmoPoker system works based on an original poker gaming environment, players can seamlessly proceed to a practice phase from the training phase, and vise versa.

As illustrated in Figure 1, EmoPoker consists of four main components: a PC, sensors, actuators, and conventional poker items (e.g., table, chips, and cards).

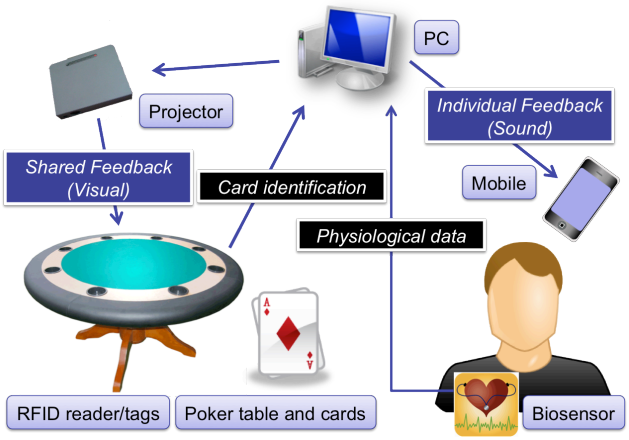

Figure 1. EmoPoker system overview

Wearable sensors, such as a wireless heart rate sensor, are used to monitor players' physiological state. RFID readers and tags are used to track card moves on the table. The readers are embedded into the table, and thin tags are put on the cards' face side (i.e., face-down cards are indistinguishable). Actuators are used to provide auditory and/or visual feedback to the poker players. For example, the heart beating sound is played by a mobile device. Such audio feedback could be shared among players, but in the self-training scenario, an individual player is assumed to be listening to the sound through earphones. It is also possible to provide individual visual feedback on the mobile phone (e.g., heart rate transition as an animation graph).

A projector is used to display shared visual feedback to all players. In addition to audio feedback, arousal level can be conveyed visually. For example, when a player gets excited, EmoPoker spotlights them with ambient red light. In this case, players share the visual information, so this feature simply invents another poker playing style (i.e., system reveals poker face). This could also be a way to introduce a balancing factor between skillful players and novices. For example, if only the skillful players' arousal levels are disclosed in the shared visual feedback, novices can use this hint to distinguish whether the experts are bluffing or not. Visual feedback is also used to guide the gaming process. Poker rules are sometimes complicated for novices. EmoPoker can project guiding information onto the table, such as the dealer and the round's minimum bet, etc.

The EmoPoker system runs on a conventional PC, and it receives and analyzes physiological data transmitted from the physiological sensor. The PC is also connected to RFID readers so that identified card position is restored to a database. We use an open source poker software PokerTH[1] as the game's logic engine.

3. FUTURE WORK

Currently we proceed with two tracks in this project: EmoPoker system development and experimentally testing the sonification design. Whereas EmoPoker has lots of potential use cases, we are particularly interested in how the technology can improve poker players' game performance by providing biofeedback. Thus, in parallel to the system development, we are planning to conduct a user study for experimentally assessing the following questions: *How does a sonified heart beat contribute to calming down a player's emotional arousal?,* and *How does biofeedback affect gaming performance?*. In order to evaluate the effects of biofeedback, a video poker system (i.e., modified PokerTH) was prepared. The user study will be conducted as a controlled experiment. Based on the experimental results, we will discuss an effective sonification design for the tilted brain, as well as what physiological data is most useful for sonification purposes. Moreover, even it is well recognized that emotional arousal affects decision-making process, the question of whether an indicator of emotional arousal improves gaming performance has not been validated yet. Thus, a study addressing this hypothesis will provide valuable information for EmoPoker development, in particular, and also other forms of biofeedback training.

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