

# eMuu – An Emotional Robot

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## ABSTRACT

In this paper, we describe eMuu, an emotional robot, its implementation and our research questions for an upcoming experiment in which we will investigate user's interaction with eMuu.

## Keywords

Emotions, Robot, Enjoyability, Facial Expressions

## INTRODUCTION

Many studies have been performed to integrate emotions into machines. Already products and studies are available which use emotions.

Products range from computer games (The Sims, Electronic Arts, 2000), to toys (Tamagotchi, Bandai, 2000), software agents (Microsoft's Persona Project, Bell et al. 1996) and robots (Aibo, Sony, 1999). Studies covered poker playing agents (Koda 1996), multi agent worlds (Elliott, 1992; O'Reilly, 1996; Cañamero, 1997) and robots (Breazeal, 1999; IBM, 2000).

The question, however, whether machines would benefit from having a character in general is still ongoing and is not in the focus of this project. There are, however, studies (Doyle, 1999; Koda, 1996; Rizzo 1999) that suggest that the educational and entertainment domain is appropriate for emotional characters. We consider the ubiquitous home as a promising application domain for the embodied emotional character. The character could become the "home character" and function as the interface between the user and the home. The user could instruct the character to switch on the TV in the same manner as requesting to raise the temperature in the room.

In our experiment, we would like to imitate such an interaction between a user a home character. Therefore we study a negotiation task, which is a good abstraction of such an interaction. The negotiation situation is set up to allow for an integrative solution (Beach, 1997) and hence promote co-operation.

Though, speech is the most natural modality of interaction with such a robotic home character it is not necessary that the robotic character talks to the user. It is more important that the character listens to the user.



Figure 1: eMuu

An important aspect of the implementation of emotional characters is not the character itself, but the technology behind it. A character based on speech technology might be very emotional, but it will still not lead to a higher user satisfaction if the speech recognition does not work properly. Therefore it is important to match the appearance and interaction of the character with the technical abilities of its host system.

We will perform an experiment with users to investigate:

- Will the user perceive the negotiation with a character more enjoyable than without a character?
- Will the user perceive the interaction with a physical character more enjoyable than with an screen character?
- Will the user perceive the interaction with a character that uses affective expression more enjoyable than with a character that does not use affective expressions?
- Does the cultural background of a user influence his/her negotiation behavior?
- Will the interaction with a character, which uses a Western European negotiation style, be perceived more enjoyable by Western Europeans than by Japanese users?

## IMPLEMENTATION

The eMuu software consists of 3 components (see figure 2). The game engine, which implements the negotiation task, and the character engine, which controls the behavior of the character, are running on a PC using JAVA (see figure 2). The emotional reasoning is based on the OCC model (Ortony, 1988).

The emotion engine, which controls the emotional state and the facial expression, is running on 2 LEGO Mindstorms RCX (LEGO, 2001) inside of the robot and communicates with the PC via infrared. Since infrared communication is rather slow we limited the communication to the exchange of emotional states and behavior control. The software for the RCX is written in JAVA and runs on the leJos (Solorzano, 2001) firmware, a Java Virtual Machine for the RCX.

System Architecture for eMuu

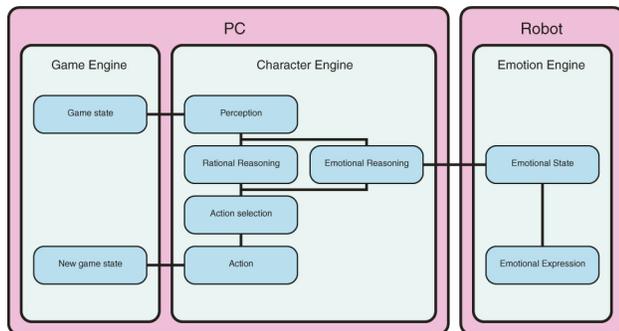


Figure 2: System Architecture of eMuu

This architecture builds on Sloman's (Sloman, 1999) evolutionary approach of the mind. The emotions and sensor-motoric control are in the lower part of the conscious (the processor inside the RCX) and the reasoning in the higher conscious (the PC). The outer shell of eMuu (see figure 1) is based on Muu (Okada, 2000) and the facial expression are based on previous work by Bartneck (2000).

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