SenToy: a Tangible Interface to Control the Emotions of a Synthetic Character

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ABSTRACT

In this paper we describe how to control the emotional states of a synthetic character in a computer game using a tangible interface named SenToy. SenToy is a doll with sensors in its arms, legs and body, which allows the user to influence the emotional state of his controlled character by gesturing with the doll. In general, SenToy works as a new type of interface to the role playing game, FantasyA, where players must exhibit a particular set of emotions and perform a set of actions as a way to evolve in the game. The evaluation of SenToy has shown that the users were able to express the desired emotions to influence the synthetic characters, and that overall payers liked the doll as an interface.

1. MOTIVATION

Moving beyond the current dominant model of Graphical User Interfaces and direct manipulation, bound to computers with a rectangular display, windows, a mouse and a keyboard is the aim of the area "tangible interfaces" [1]. The idea is to get rid of the limited communication channels and explore new channels of interaction such as gestures or touch. Following this idea, SenToy aimed as serving as an interface to the role playing game (FantasyA) where players must exhibit a particular set of emotions and perform a set of actions as a way to evolve in the game . Emotions play a central role in the game, since it is through mastering of the emotion expression of the controlled characters in the game that users can evolve in the game and win battles against their opponents. So, the aim of SenToy is to "pull the user into the game" through the use of a physical, touchable affective interface.

2. THE DESIGN OF SENTOY: A WIZARD-OF-OZ STUDY

The design of SenToy started with a study to determine how users could express emotions though the handling of a physical doll. For example, what kind of gestures would be the best ones to express "anger" or "happiness"? Our first inspirational source was studies on gestures and emotions. For example, according to Darwin, joy is portrayed with open arms and rhythmic movements such as clapping. However, how do users respond when controlling an avatar's emotional state through a doll? Do they follow a specific pattern of gestures? To answer these questions, and thus inform the design of Sentoy, we performed a study using the Wizard of Oz method. In the study, users were placed in front of a "controllable" synthetic character (Papous) and were asked to control the character's emotions through a plush toy. They were told that the plush toy had sensors in its arms and that they controlled Papous, while in reality it was a human "Wizard behind the scenes" who controlled the character Papous. When the Wizard recognised a movement pattern according to the scheme elaborated using emotion theories, she made Papous express that emotion. In the study, it was found a set of movements which used more often to express the emotions through the fake SenToy, see next table for the most common gesture used by the users.

Emotion	**Most common gesture**	No.
Anger	Boxing with its arms	12
Fear	Hands in front of eyes	8
Disgust	Arm in front of face as wiping something away	10
Happiness	Dancing and jumping (continuous movement)	16
Sadness	Bending down its trunk	16
Surprise	Arms in air, frozen position	16

The results achieved by this experiment (see [2] for more details on the study) show that for certain emotions (happiness, anger, fear, sadness, surprise) there were clear recognizable pattern of gestures that users followed for controlling the emotional state of the character. We also got interesting feedback on how the doll should be designed to best fit with the purpose. Three dolls were tested: a teddy bear, a puppet "Pippi Longstocking" and a SuperModel Barbie Doll Kenneth. Users preferred the soft and cuddly teddy bear prior the hard plastic Kenneth. They preferred a doll with neutral facial expressions.

3. SENTOY IMPLEMENTATION

Based on the results obtained by the Wizard-of-Oz test we developed the first prototype of the SenToy, and integrated it into the computer game FantasyA.

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AAMAS'03, July 14–18, 2003, Melbourne, Australia.
ACM 1-58113-683-8/03/0007.

The SenToy is an explicit sensorial interface equipped with three sets of sensors. The first and most important is the set of accelerometers, which provides the acceleration that the SenToy is subjected to. The other type of sensors is analogical and used to determine the limbs position. The third kind are digital, and are used to indicate whether the hands of the doll are placed over the eyes or not. Since the emotions/actions cannot be obtained directly from the rather complex data received from the SenToy sensors, a signal processing module was required. This module was build to capture the patterns of each of the 6 chosen emotions (described bellow).

Anger The most general form of shaking the doll is to move the doll back and forward in short but fast movements. These movements cause accentuated variations of the acceleration value given by the accelerometer on the X axis.

Fear The SenToy's hands placed over the eyes, independently of the arms position. The SenToy's body must be in an erected position.

Joy To represent the joy emotion, the user makes the doll dancing and/or jump up and down (especially jumping). For these movements, the variation of the SenToy's position is predominantly on the X axis, with wide and rhythmic variation.

Sadness The sadness emotion is represented by bending the doll forward to the horizontal plan. This position originates a reduction on the angle between the legs and the trunk.

Surprise The surprise emotion has an asymmetrical sequence of rules, the first corresponds to the movement of jumping back, and the second movement (or lack of it) corresponds to the SenToy laying inclined backwards with its arms open slightly to the back.

Gloat To express gloating the user has to perform the same gestures as happiness and at the same time point the right arm to the front.

Finally, concerning the look and fell of SenToy, we decided to make a soft and cuddly toy instead than the hard plastic one (because the user's preferred it in the first Wizard of Oz study). The SenToys exterior was created using a soft fabric, filled with latex and covered with a kind of skin made with lycra (see 1).

4. STUDY AND RESULTS

In the most recent study we have been able to use the working prototype SenToy doll to test whether people understand and naturally use the actions and gestures identified in the previous WoZ study, and also to evaluate how successful SenToy doll is, as an interface to a computer game. The study was performed with 34 subjects ages ranging between 9 and 45 years. The results showed that emotions such as happy, sad and anger worked really well. Gloat was hard since most pointed with the right arm, as intended, but did not simultaneously dance with the doll (as in the happy expression). Surprise was most difficult from a sensor point of view. Once users were given instructions on how to perform the gestures and then subsequently started to play the FantasyA game, the only emotion that was entirely avoided was surprise. This can be due to the fact that this emotion did not have a natural place in the game, but we suspect that it was also because it was quite hard to perform. Gloat was used frequently with great success. After the session with FantasyA, users did some questionaires and interviews to assess how the users felt about SenToy. In general, kids liked SenToy more than adults. In the interviews, two kids commented that they would have liked to have a doll each and be able to play against each other. Players often got very involved with the doll and the game. Often this was expressed through bigger movements with SenToy.

Many players cuddled the doll throughout the interview (after the game). They liked the size, compared it to a child, and seemed to enjoy its weight and design.



Figure 1: SenToy

5. CONCLUSIONS

In summary, we can say that creating a tangible, sympathetic interaction device such as SenToy for affective input turned out to be both possible and even quite successful. It encouraged a more tactile interaction, players did identify with it, and the size, shape and behaviours were close enough to what they should be. While there is still some fine-tuning to be made, we believe that SenToy can be used in several different interaction scenarios with synthetic characters - ranging from games to training of autistic children. It is not a device exclusively useful in the FantasyA game.

6. REFERENCES

[1] H. Ishii and B. Ullmer. Tangible bits: Towards seamless interfaces between people, bits and atoms. In *Proceedings of Conference on Human Factors in Computing Systems (CHI'97)*. ACM Press, 1997.

[2] A. Paiva, G. Andersson, K. Hook, M. D., C. M., and M. C. Sentoy in fantasya: Designing an affective sympathetic interface to a computer game. *Personal and Ubiquitous Computing*, 6, 2002.