Watch and Feel: An Affective Interface in a Virtual Storytelling Environment

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Abstract. In this paper we describe a study carried out with SenToy: a tangible interface that has the shape of a doll and is used to capture emotions from its user whilst performing specific gestures. SenToy was used with an application named Fearnot!, which is a virtual storytelling environment, where characters act autonomously and in character, so that stories emerge from those autonomous actions. The integration of SenToy in FearNot! was evaluated in two ways: (1) if users were able to manipulate the tangible interface appropriately, even if engaged in storytelling situation and (2) if the emotions expressed by the users with SenToy were the same as the ones reported to have been felt after the session. The results of the study show that Sentoy can be used to understand how the viewers reacted to the stories portrayed, and at the same time that the emotions that were expressed with SenToy (apart from some exceptions, reported in the paper) are indeed similar as the ones reported to have been felt by the users.

Keywords: Affective tangible interface, affective computing, synthetic characters.

1 Introduction

The interaction between humans and computers has evolved significantly over the last few years. Line-driven commands were replaced by sophisticated Graphical User Interfaces, which are most common nowadays. However, alternative approaches have recently been proposed, one of them is the use of Tangible User Interfaces (TUI) [5]. The philosophy behind TUIs is to allow people to interact with computers via familiar tangible objects, therefore taking advantage of the richness of the tactile world allowing the users to interact with the computer in ways that are more intuitive and natural.

In this paper we explore the use of an affective tangible interface as a way to get feedback from users interacting with a virtual storytelling environment. Interactive and Virtual storytelling, in general, allows for users to become emersed in a story, where they can act and thus affect the development of the story. Several approaches have been taken in the way in which the story is affected by the

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actions of the users. For example, users may act as "Gods" [4] in the story, as participants (thus having their own characters in the story) or simply as mere audience.

In this paper we show how a tangible interface can be used as a way to gather and thus adapt stories to actions performed by users with a tangible interface. To do that, we have used an affective tangible interface, SenToy [2], which detects a set of emotions that the user may want to transmit through a set of gestures. SenToy was used to collect emotional data from users that were watching a story.

Our goals with this work were: (1) test if users were able to manipulate the tangible interface appropriately, even if engaged in storytelling situation and (2) if the emotions expressed by the users with SenToy were the same as the ones reported to have been felt after the storytelling session.

The results of the study show that SenToy can be used to understand how the viewers reacted to the stories portrayed, and at the same time that the emotions that were expressed with SenToy (apart from some exceptions, reported in the paper) are indeed similar as the ones reported to have been felt by the users.

The paper is organised as follows: first we will give a brief overview of SenToy and of the storytelling application. Then we will describe the experiment done with 9 children and discuss the results obtained.

2 SenToy

SenToy is a tangible interface that has the shape of a doll and has the ability to detect gestures that represent emotions expressed by the user. SenToy is used within a system with two elements, the doll itself which is responsible for acquiring all the information regarding its handling by the user, and the computer that receives the data from the doll and proceeds by doing its processing and interpretation giving as an output an emotion with a certain certainty value. A picture of SenToy is given in figure 1.

Fig. 1. Picture of *SenToy*

The patterns interpreted as emotions described in table 1. These patterns were decided after some design experiments (using a WoZ methodology) conducted with users (see [2]) and dolls.

Table 1. Patterns associated with emotions

Gesture	Emotion
Move the doll up and down	Happy
Slightly bend the doll's head onward	Sad
Agitate the doll vigorously	Anger
Cover the doll's eyes with it's hands	Fear
Incline the doll's body backwards and making the doll move backwards	Surprise

In the concrete case we are exploring, only four emotions were considered, which were: *Happiness*, *Sadness*, *Anger* and *Fear*. The other two emotions did not make sense for the storytelling application we wanted to consider.

3 FearNot!

Fearnot! is a 3D virtual storytelling application created for an European-funded project named VICTEC which goal was to investigate the technologies required to evoke an empathic responses between users and synthetic characters[6]. The creation of empathy is seen as a way of involving the user emotionally in improvised virtual drama in an area of Personal and Social Education (PSE), and specifically in this project that of anti-bullying education for children aged 8-12. Thus, FearNot! [3] features a virtual world inhabited by synthetic characters (that portray children) that act autonomously according to their goals and roles in the story. The roles can be "bully", "victim", "bystander" or "helper". Bullying episodes are generated by the actions of the characters in the world. The whole story is divided into episodes, "bullying" episodes. The users influence the development of the story by providing advice to the victim on what to do next.

In order to control the experiment, the version of FearNot! used in this research consists of a set of scripted scenarios, that include an introduction, where the characters of the story are presented (John, the victim and Luke the bully), then a bullying episode is shown followed by a phase were questions are asked to the users about the bullying episode. Then, according to the users' answers the path of the story evolves, and in the end an educational message is given to the viewers.

The scripted story used in this research was a story of physical bulling, where a bully (Luke) pushes the victim's (John) books to the flor and mocks him. After this bullying episode the victim asks the user for advice (the victim interacts with the user in a corner of the library) and according to the advice given by the child user a new episode is chosen. The second episode's scenario is a football game where again, the bully attacks John verbally. In this episode a "helper" comes to John's rescue. Finally, in the last episode John is again helped and John thanks for it.

4 Fearnot! with SenToy

The objective of using SenToy in FearNot! was to allow for further interaction of the users with the application. Also, our main research questions were also to test if users were able to manipulate the tangible interface appropriately, even if engaged in storytelling situation. So, in technical terms we had to embed SenToy's components into the FearNot! application. Furthermore, as users were allowed to use SenToy all the results of that interaction needed to saved in a log file containing information about which emotions and in which part of the story those emotions were expressed with SenToy.

As the episodes in FerNot! were defined in script files, some new information had to be added to the script files, so that the logs could record which part of the story was being displayed when the user used SenToy to express an emotion. To do that, changes were made to the ViewManager (an agent in the architecture used to built FearNot!) which is responsible for the parsing of the script files. The architecture of the new system is shown in figure 2.

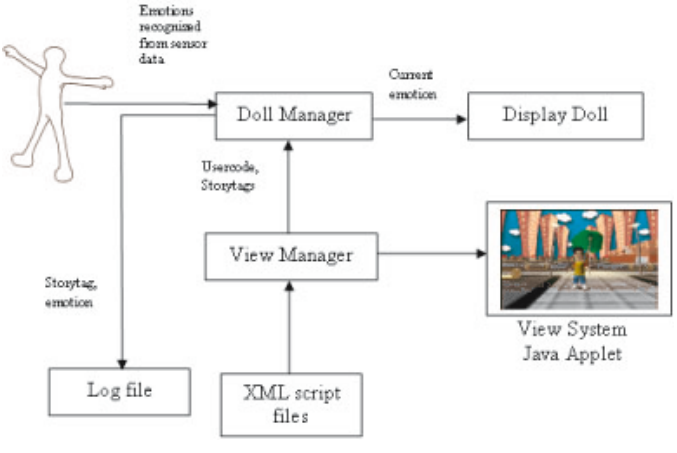
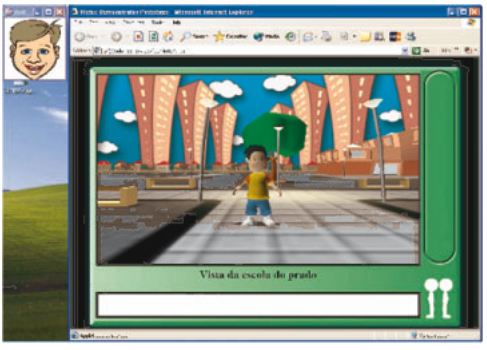


Fig. 2. Functionality added to Fearnot!

In the shown architecture the *ViewManager* is responsible for controlling the scripted story displayed in the *ViewSystem*. The *Doll Manager* is responsible for maintaining a state that describes what emotion was last received from SenToy, which part of the story we are currently in, and creating a log file with this information. The *Doll Manager* is also responsible for sending the current emotion to *Display Doll* which is the component responsible for displaying a cartoon face with emotions in the screen each time a new emotion is detected.

The cartoon faces were used as a way to provide immediate feedback to the child on what emotion she/he was expressing. These were immediate reactions to the gestures made with SenToy. For example, if the user expresses happiness with SenToy a cartoon face which represents that emotion will be displayed in the screen and will change only when the user expresses a different emotion. The cartoon faces were taken from [7] and are shown in figure 3 (a).

(a) Cartoon Facial Expressions used as a feedback to the SenToy gestures



(b) Fearnot! and the window that displays the emotions detected from Sentoy

Fig. 3. Cartoon facial expressions

The cartoon face is displayed at the left corner of the screen as shown in figure 3 (b).

5 Results

In order to evaluate the impact of SenToy within the context of FearNot! we randomly chose eight children aged between eight and eleven years and we let them use FearNot! and SenToy. Before the experience the children were given some time to try out the gestures needed to express emotions.

The experience was carried out individually and in the end the session, each child filled a questionnaire about the characters of the story, the conversations, how much the liked using SenToy and about the easiness of expression of the emotions. Apart from the log files obtained, all the procedure was filmed for further analysis.

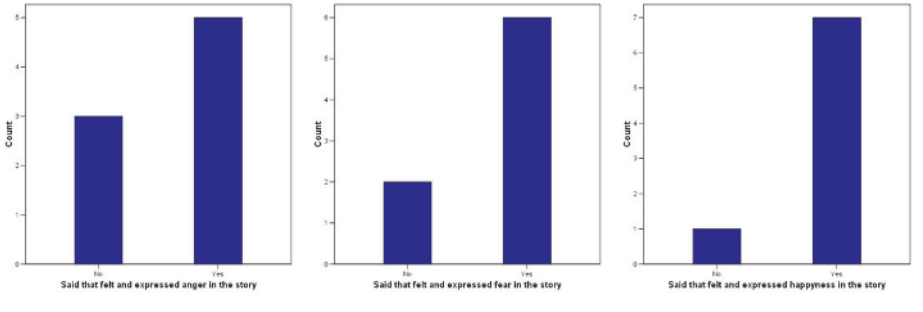


Fig. 4. Discrepancy between the emotions and the answers to the questionnaires

	Child 1	Child 2	Child 3	Child 4	Child 5	Child 6	Child 7	Child 8
The victim is presented				Sad		Happy	Fear Sad	
The victim talks about his problems	Sad		Sad		Sad	Sad Happy	Sad Fear	
The neutral character is presented			Fear	Angry		Happy	Angry	Sad
The victim is studying, the bully is coming close to him						Happy		
The bully throws the victim's books to the floor					Angry Sad	Happy	Angry	
The bully pushes the victim to the floor when the victim was trying to pick up the books		Sad		Sad			Sad	Sad
The bully mocks the victim after throwing him to the floor	Sad	Sad Angry	Happy	Sad	Sad Angry	Sad	Sad Happy	Sad Happy
In the library		Sad	Sad	Sad Happy	Fear	Sad	Sad	Fear
The user is being asked if he can help the victim	Sad Angry Fear	Sad	Sad Fear	Sad	Fear Sad	Sad	Sad	Sad
The football encounter		Happy Sad			Angry	Happy	Happy	
The bully hits the victim because he didn't pass him the ball		Fear Sad		Sad	Angry	Sad	Happy Sad	
The bully mocks the victim after hitting him for not passing the ball		Angry Sad			Sad Happy		Sad Fear	Sad
The neutral character says to the bully that he must leave the victim alone		Angry	Sad		Happy	Sad	Fear	Sad
Going to the library							Fear	
The user is being asked if he can help the victim for the second time		Angry Sad	Sad			Sad	Fear	
The victim faces the bully		Angry Sad	Sad		Sad		Sad Fear	
The neutral character makes an intervention, not allowing the bully to hit the victim again		Happy	Sad Happy			Happy		
The victim tries to hit the bully				Sad	Sad		Fear	Angry
The victim thanks the neutral character	Happy	Happy	Happy					

Fig. 5. Log with emotions

Figure 5 summarizes the analysis made on the video footage and its combination with the captured log files.

From the logs obtained, the results show that the emotion that was expressed more often was sadness. This is in accordance with the contents of the displayed story. Furthermore, as can be seen from the table 5 children did express sadness at the right moments (for example when the bully pushes the victim, or when the victim faces the bully). Indeed, most of the children expressed emotions that were in accordance with what was being displayed in the story. There was one exception in the group of eight children, where the child just considered SenToy as a doll and used it like a toy an not like an emotional interface, thus not paying much attention to the story, and spending most of her time playing with SenToy and making the cartoon face display whatever she wanted.

At the end of the session we asked children what they had experienced during the story and the results were compared with the logs of what they had expressed. Although the results show that in general they are similar, there were some small differences found between what children said they felt and what was in the log. Figure 4 illustrates these differences. The graph about the sad emotion is omitted because every child said and indeed expressed that emotion during the story. In the case of the other three emotions, especially anger, there are several cases where the children expressed it but didn't mention they felt it in the questionnaires. In the case of the fear emotion, there was one case where there was a big discrepancy, as the emotion was expressed fifteen times during the story but the child said she never expressed it, but this child was the exception already mentioned above. Finally, in the case of happiness, there was one disagreing case, where the emotion was expressed three times but the child said she never felt it during the story.

Although the results show that indeed SenToy can be used as a way to capture the emotions, even if users are engaged in a storytelling scenario, these differences detected can have several implications. One explanation is that children may have forgotten that they expressed a particular emotion and their evaluation at the end only reflects what they got at the end of the session. Another explanation is that they may have made a mistake and expressed a wrong emotion instead of the one they originally wanted to express (although this is less likely as the emotions are expressed in very different ways[1] so it is very difficult to an emotion to be wrongly detected).

6 Conclusions

In this paper we have reported an experiment of using SenToy (a tangible affective interface) in the context of a virtual storytelling application. The use of SenToy was very positive not only because it confirmed again that children really liked SenToy but also because it allowed us to gather emotional data about the users of FearNot!.

The data captured, shows that indeed children felt sadness (as expected). Other emotions, such as anger or fear, the results show that there were some

differences. Furthermore, the analysis made on the data collected also indicates that this kind of interface can be a distraction, (in this case some of the users were more interested in the interface than in the story).

However, and as a final comment, we believe that further studies should be performed investigating how tangible interfaces can be combined in virtual storytelling.

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