Children as Affective Designers
I-Shadows Development Process

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Abstract

The following text describes a user-centred prototyping development process that is being used in GAIPS INESC-ID, to produce an affective system for children, named I-Shadows. This system uses Chinese Shadows as an interaction metaphor to help children build a logical narrative for an audience.

Introduction

Imagine a dark room full of children where suddenly a new world gains form with a light beam. Imagine that this new world is filled with coloured intelligent and interactive shadows, in which you can participate with your own shadow. Other intelligent shadows participate and help children to build the virtual and real worlds of Interactive Shadows.

Figure 1 - I-Shadows installation

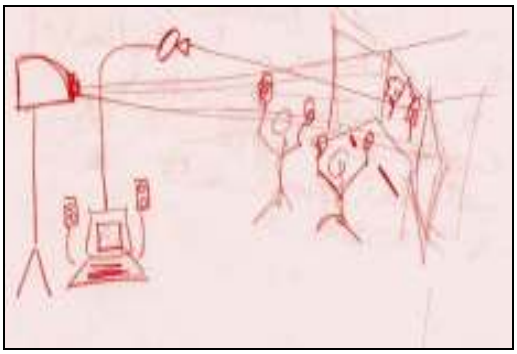

Figure 2 I-Shadows components

The previous paragraph describes the conceptual model of I-Shadows. Our main goal in this project is to help children achieve logical narrative on-the-fly, by reacting to the emotions and intentions that children express through shadows' manipulation in an intelligible way. These emotions and intentions are detected by a system that integrates a computer, a projector, a video camera and a shadow screen. The computer uses a camera, a projector and a vision algorithm to interpret real actions and project virtual elements, such as characters and sounds onto reality at the same time.

The following text describes the method that is being used in this project to test and involve users in the design process.

Method

Developing an affective loop where users' expressions have a special role raises two difficulties:

- How to understand and compute users' expressions with I-Shadows
- How to express emotions in an intelligible way

Our approach to these questions consisted in considering them as the need for coherence between users' expectations and shadows' emotional expressions. To achieve this coherence we propose that computer generated expressions should be as similar as possible to the user's expressions. Before

generating emotional impact we have to learn from the users how they express it. This is how we concluded that users should be involved in the design process as soon as possible as in Sentoy[1].

The involvement of users in the design process raises some known difficulties: it's a time consuming task; it's hard to find appropriate users; users are often not committed to the project, etc. In addition, we must consider that, because our users are children, they need some special attention to keep focused on the objectives of each experiment.

Our main concern when involving children was to assure that they wouldn't feel tested and observed but rather authors and participants in the design of a new and different kind of game. We wanted them to be as natural as possible to achieve more accurate results. To overcome these difficulties we defined four rules:

- Children are members of the development team as users.
- All team members' opinions are important.
- Children collaborate, and are not developers.
- Children and adults have fun, but only adults take notes.

To implement these rules, and concerns, we adopted a fast prototyping method, which allowed children to participate in several experiments from the beginning of the project until the present day.

Development Process and Tests

The I-Shadows' development process consists in managing the interaction between two main activities: Implementation and Tests. This interaction management can be seen as a loop that begins with the users' requisites that guide the implementation of a solution, and closes with the users' evaluation of that implementation which raises new requisites to be considered in the next implementation.

Five different kinds of tests were already made until the present day: Acceptance Tests, Observation Tests, Design Workshop, Expression Tests and Expression Recognition. All tests are being held at a local school, and are included as a free activity in which they can choose to participate.

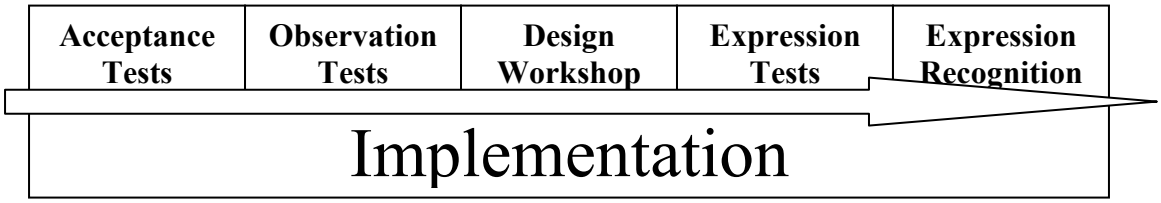

Figure 3 – Development Process

Acceptance and Observation Tests

It wouldn't make any sense to build such a complex installation as I-Shadows if children didn't like it. Consequently we had to test children's acceptance of the idea. For that, we built a non-functional prototype of I-Shadows that embedded a simple Chinese Shadows Theatre.

This Prototype was also used with success to see how children expressed, and how they created narratives using it. The results of these tests included a non-quantitative definition of four different patterns of expressions, which corresponded to four emotions, Happiness, Sadness, Anger and Fear. These results can be seen in *Designing Affect in a Chinese Shadows Theatre*[2].

Other conclusions reached with these tests were that children like the I-Shadows concept, accept suggestions for starting a narrative, as well as they need it to keep their narrative logical enough to be seen by an audience.

Design Workshop

While implementing a first functional prototype with the requisites and patterns taken from the first experiments, we had to support the users' continuous integration in the development process and make them feel like developers. Due to this, we prepared a Design Workshop, where children were invited to create characters, and sets for their stories.


Figure 4 and 5 - Design Workshop (Left: Boy drawing; Right: Dragon's home)

The goal of this workshop was simple; we wanted I-Shadows to be as similar as possible to the users' expectations. We wanted I-Shadows to present characters and sets according to children's perspectives.

Expression Tests

This test was taken in July, with eight children (4 boys and 4 girls) aged 8. The goal of this test was to see the accuracy of the proposed expression patterns this time in a quantitative way, with a functional prototype simulated in a computer, controlled by a mouse.

The experiments were preceded by a small introduction where children were invited to play a mime game within the group. "*This mime game has some special words. These words are emotions like Happiness, Sadness, Fury and Fear*". Once the game started to slow down, we started the experiment that consisted of two tests.

1st test – After choosing two virtual puppets, from the functional prototype, a character to manipulate and a friend to play with, the test worked like the previous mime game, but it was up to their "friend" to recognize their emotion and repeat it. This test was taken in two rounds for each set of emotions (Happy, Sad, Angry and Sad). The results are shown in table 1, the 'Success' percentage means the percentage of expressions correctly detected by the prototype.

	Success (1st Round)	Success (2nd Round)
Happy	63%	100%
Sad	88%	100%
Scared	75%	88%
Angry	13%	13%

Table 1 - Tests Results

The children responded enthusiastically to the 1st experiment. Sometimes less expressive kids showed some difficulty at the beginning. However, they adapted to the game very fast by watching how the others did it.

The results were in line with the expected. All patterns except for Angry showed a significant value above the random value. Most of the children showed great difficulty when trying to produce the Anger pattern, because of its high speed, which made them loose control over the mouse.

2nd test – Everyone should try to show their "friend" how he should move when he is angry. The movements' quantified data was collected and a new Anger pattern was implemented.

Fifth Experiment – Expression Recognition

In November 2005, we were ready to test the generated expressions of the animated shadows. The experiment involved 10 children (7 boys and 3 girls).

In this test children were invited to guess which spell (emotion) a computer generated shadow was experiencing. The Anger pattern used was the improved version due to the previous test. The results are shown in table 2.

	Success
Happy	70%
Sad	30%
Scared	40%
Angry	50%

Table 2 - Expressions' recognition

Three expressions showed a significant value above a random distribution, which makes us believe in the success of this test. The Sadness expression presented a low success percentage. We interpret this result as an alert that points out the incoherence between the sad expression animation patterns defined by the children.

Afterwards in an informal chat, children mentioned that the lack of facial expressions and sounds of the character made their task more difficult. We also considered by observation that the lack of context in which the expressions occurred might have led to the low results of some expressions.

Conclusions and Future Work

At this point of the project we feel that the obtained results are very satisfying. We are able to detect three users' expressions with success, and to express other three in an intelligible way. We will continue testing these first patterns and we expect to improve our success margins with the Anger detection and the Sad Expression.

Children's excitement when we visit them in order to test the prototype (plays), convinces us that their expectations are being met, and that, consequently, our development method is succeeding.

The next step, after resolving the expression's recognition, is to achieve the context concept by creating high level actions, based on these primitive expressions. These high level actions must accurately correspond to the characters' behaviors so they can act in a believable way and create an effective affective loop.

References

[1] Paiva A., Costa M., Chaves R., Piedade M., Mourão D., Sobral D., Höök K., Andersson G., Bullock A. **SenToy: an Affective Sympathetic Interface**, *International Journal of Human-Computer Studies*

[2] Ana Paiva, Mafalda Fernandes and António Brisson, **Designing Affect in an Interactive Chinese Shadows Theater**, HUMAINE WP6 workshop 10-11 March 2004, Paris