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Bubble Caster – A Mixed Reality Children Application for Interactive Shadow Play

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ABSTRACT
In this paper, we describe how the mixed reality application, *Bubble Caster*, technically works and how we involved children ages 7 to 8 in the design process. The children used their storytelling and programming skills to produce the interactive, mixed reality shadow play, *The Magic Cauldron.* The project enabled the children to acquire elementary programming skills in a playful learning environment.

KEYWORDS
Picture recognition, computer vision, mixed reality, immersion, collaborative learning, elementary schools, children technology

INTRODUCTION
In the KiMM (Kids in Media and Motion) initiative [1] we are following an approach, which places an emphasis on using digital interactive technology in elementary schools and high schools within the students' daily learning environment [2]. KiMM has evolved from the experiences and results of a previous project (ArtDeCom), where children created digital augmented multi-sensory learning spaces combining arts and computer science in schools [3]. The former project established the groundwork for creating collaborative and constructive learning installations and performances [4].

THE "*BUBBLE CASTER*"
At the University of Luebeck, Germany, we developed a software application called, Bubble Caster. The program has been developed in collaboration with young children of two grade schools. The application assists elementary school children in their expressive skills in the context of collaborative tasking and performance. The system is based on an application called the "Shadow Caster" [5] where bubbles are projected onto a wall and the shadows from people standing before the wall (between the projector and the wall) interact with the projected bubbles.
Bubble Caster modifies and supplements the "Shadow Caster" with an interface (cf. Figure 1) that allows children to create their own semantic bubbles. They fill (import) their bubbles with their own drawings, graphics, or photos. Then they define the dimension and the position of the drawing in the bubble. They designate self-composed music to each bubble. Finally, they define the number and the order of appearance of the bubbles on the wall.

Figure 1: Interface of the *Bubble Caster*

INVOLVING CHILDREN IN THE DESIGN PROCESS
Inspired by the cooperative design practice of Gustav Taxen, Allison Druin, and others, [6, 7] we started to involve children in the design process in our applications. We watched closely and interviewed the children handling the different prototypes. The children brought their wishes, suggestions, and ideas in the process of the development.

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Example of Using the *Bubble Caster*: Designing and Programming the interactive Shadow Play, *The Magic Cauldron*

The goal of this project is for the grade 2 children to explore their worries and joys and to use their storytelling and media literacy skills to express these feelings. The children create film, pictures and sounds which depict sad and happy situations. The application *Bubble Caster* allows the children to place their articulated feelings into bubbles. These bubbles (i.e. their emotions) are projected on a wall and the children move the bubbles with their shadows into a magic cauldron, where they disappear (Figure 2). The children designed this interactive mixed-reality play in the following three steps:

- First, they explored how various emotions are expressed in color and form; happiness, sadness, joy, worry, fear, anger, etc. were drawn on paper and scanned, or draw with a computer graphic program (ArtRage).
- Secondly, they composed music and sound effects. The children experimented with and recorded these sounds with different instruments.
- Finally, they took the photos, drawings and sound effects and produced bubbles, as well as programmed the sequence of appearance with the *Bubble Caster* software.

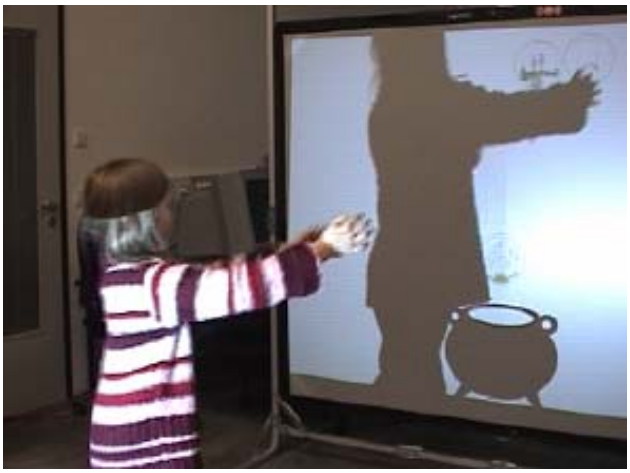

Figure 2: Moving the bubbles into a magic cauldron

The bubbles produced in this program were then projected onto a backdrop and used in the play to represent the children's worried and joys.

DEVELOPING PROGRAMMING SKILLS

As with Seymour Papert, we agree that programming skills are a key part of the intellectual development of children [8]. With the KiMM initiative [9], and here for example with the Bubble Caster, we demonstrate that children, even in elementary schools, can and should learn to control a digital system with elementary forms of programming (see also our concept of evaluation, [10]). The children tell the system how it should react interactively. In connecting physical and digital action spaces, they create a digitally augmented action space by themselves.

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