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DESIGN SKETCH

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# Tagaboo: a collaborative children's game based upon wearable RFID technology

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## 1 Introduction

Tagaboo is an interactive game for two or more children that is based upon wearable radio frequency identification (RFID) technology. Tagaboo combines aspects from traditional athletic children's games with tagged physical objects that are bound to different sounds and behaviors. These objects (tokens) are hidden in pockets that are placed on a wearable vest (Figs. 1, 2, and 3). While one or more children wear such vests, children may "seek" for tokens using a special glove, which is embedded with an RFID reader and computing capabilities. We believe Tagaboo suggests new potentials for applying RFID technology in both children's games and wearable computing.

## 2 Concept

Our motivating interest was in interactive, computationally enhanced physical games for young children involving two or more players. We sought to draw from traditional games that require interpersonal interaction. "Hide and Seek" encourages imagination. In "Tag," athletics and coordination play a major role. In "Memory," memory and recall are key underlying skills.

With Tagaboo, we worked to combine some of the strengths and requisite skills from these games into a single, computationally enhanced game. In the basic version, "hiding and seeking" plays the dominant role. Tagaboo's basic goal is to find as many hidden tokens as possible within a certain period. The discovery of a hidden token is revealed by audio playback, potentially, as well as triggering additional digital behaviors (e.g., gaining or losing points).

Depending on the child's abilities, Tagaboo can integrate the remembering aspect of "Memory." For example, if a child touches a token a second time, the child might hear a different message and lose points. Tagaboo can also draw upon Tag's athletic aspect. Here, a child wearing the token-filled vest tries to evade a second child wearing an instrumented glove. These variations might be modified with the assistance of a parent to match the abilities and interests of the children.

## 3 Interaction

One or more children wears a vest containing RFID-tagged tokens, while one or more pursuers wear gloves with embedded RFID readers. The first child attaches a number of velcro-backed, padded pockets to the vest(s) (Fig. 3a). In some of these pockets, the child places tokens bound to different audio recordings (e.g., voice messages, sound indicators), and potentially associated with points and behaviors.

Our prototype glove is "overstuffed," and "Mickey Mouse®"-like in appearance. The glove's size and shape suggest it may have "special powers," and provide room for enclosing and padding the underlying electronics. Pushing a button on this glove begins the game. The child then tries to find as many different tokens as possible within a given time (e.g., 2 min). Each discovered token plays its corresponding sounds and indications of points and behaviors. The associated computer counts these points, and indicates these at the end of the game via voice, a display embedded within the glove, or on the screen of a supporting PDA or computer.

## 4 Related work

While RFID tags are beginning to be integrated into clothing, we believe that, along with [4], Tagaboo is

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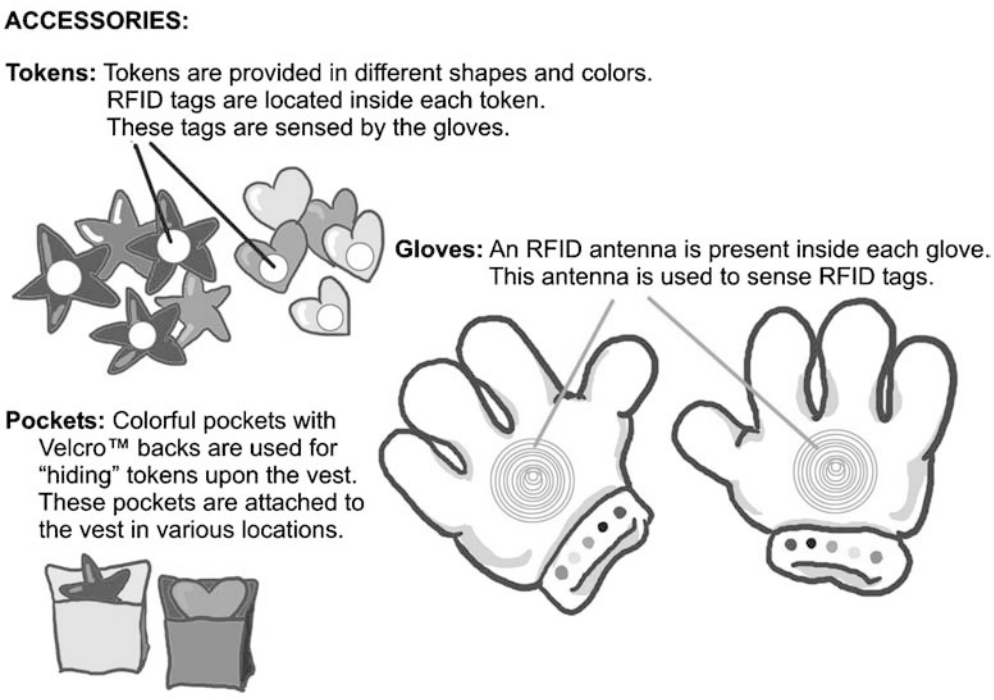


Fig. 1 Overview of system elements

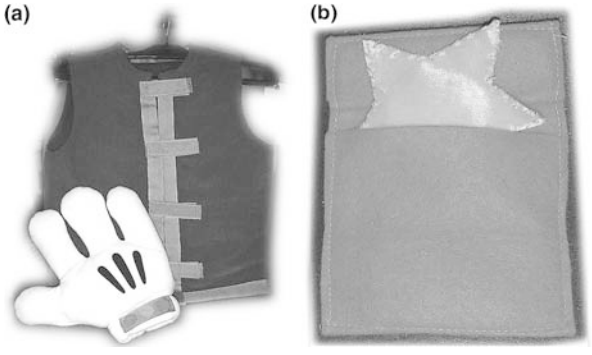


Fig. 2 **a** Tagaboo vest and glove. **b** Pocket and tag

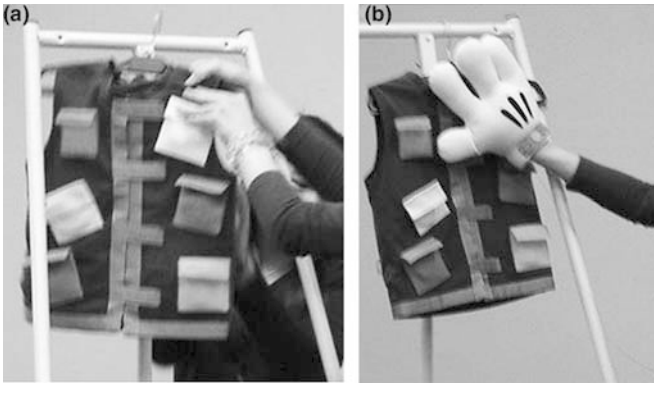


Fig. 3 **a** Placing pocketed tags. **b** Reading with the glove

among the first systems employing wearable (as opposed to handheld) RFID readers. The Zowie™ toys [2] were perhaps the first RFID-based toys. The MusicBlocks™ toy [3] uses physical blocks to represent musical elements. The PingPongPlus system [1] combined athletics with digital mediations. Location-based games using augmented reality have also been published in recent years (Fig. 4).


Fig. 4 Scenario 1: two children, seated. One child is wearing the instrumented glove. The second child is wearing a vest with several pockets attached. The pockets contain RFID-tagged objects associated with different sounds and behaviors. Example behaviors include playing and recording sounds or increasing/decreasing score during a game. Example sounds might include "explosion," "cheering," or "countdowns."

## 5 Implementation

Tagaboo is a working prototype developed as a final project in a five-week interactive systems course on tangible interfaces and RFID technology. The project was based upon small coin-shaped Philips HiTag RFID tags, each including a unique identification number. The

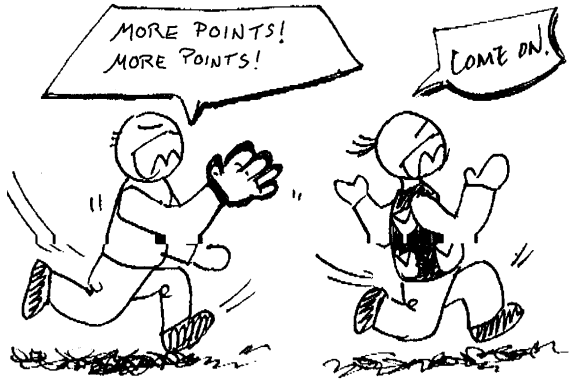


**Fig. 5** Scenario 2: two children, chasing. In the first scenario, interactions with the pockets might focus on memory and the children's interpersonal interactions. The second scenario introduces an athletic component, drawing from "Tag" and "Hide and Seek"


**Fig. 6** Scenario 3: three or more children, chasing. In this scenario, three or more children play a chasing game. In one variation, each child wears a vest and pocketed tags, while the children take turns wearing the instrumented glove. In a second variation (illustrated here), each child might wear an instrumented glove

RFID tags were embedded into small objects shaped in different forms (star, heart, etc.). Their shape, feel, and appearance were intended to make them attractive to children. In the initial prototype, the mappings between objects and bindings were not systematic. However, we imagine that shape and color are strong cues that would aid recognition by young children (Fig. 5).

The tags were sensed with a small (2×3 cm) RFID reader. The sensing antenna was embedded within the glove. For the class prototype, the reader was linked to the glove with a long cable, and then connected to a desktop PC. If deployed, the glove could either connect wirelessly to a supporting PC or PDA, or be completely self-contained (Fig. 6).

## 6 Discussion

Our goal was to realize a simple game combining features from traditional games with computing technology. We believe the Tagaboo variation that includes chasing and memory satisfies these criteria. Supporting athletics in a digitally enhanced game seems to have special potential. The physical activity of children in the developed world continues to decline. We imagine games like Tagaboo could encourage children to exercise while developing both physical and cognitive skills.

Tagaboo is also distinguished by its use of RFID technology in clothing. The tags can be easily moved into and between the pockets. The reader and supporting electronics could be completely embedded within the oversized glove, with the antenna located in the glove's palm. We believe this wearable RFID approach has special promise.

Tagaboo has the potential to be easily modifiable by users. For example, we considered adding a "recording" token. This might be used to support token-based audio recordings during the game. In this way, Tagaboo might be shaped by both adults and children into a range of distinctive, personalized variations and games.

We feel Tagaboo is a promising prototype, and could have strong potential for entering the toy market. We believe this work suggests many new directions in which RFID-enhanced games and clothing might be developed.

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