Mocotos: Mobile Communications Tools for Children with Special Needs

Mohamad Monibi
Laboratory for Ubiquitous Computing & Interaction
Department of Informatics
University of California, Irvine
Irvine, CA 92697, USA
mmonibi@ics.uci.edu

Gillian R. Hayes
Laboratory for Ubiquitous Computing & Interaction
Department of Informatics
University of California, Irvine
Irvine, CA 92697, USA
gillianrh@ics.uci.edu

Abstract
Children with special needs often struggle to communicate about even the most basic of concepts. For children who cannot verbally communicate, augmentative visual communications tools can enable them to get their needs met, to socialize, and more. Despite these benefits, the tools currently available have many shortcomings. In this paper, we present results from a preliminary formative study focused on understanding current tools, and determine needs for the design of new tools. We also present the design of Mocotos, a new class of mobile communications tools for children with special needs.

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Introduction
Autism spectrum disorders are a range of psychological conditions that introduce abnormalities in communication and social interaction. Children with autism typically do not acquire verbal and social skills without special interventions. These children are trained in Augmentative and Alternative Communication (AAC) techniques, which rely on other methods of communication that supplement speech or writing. Visual communication is one form of AAC, which relies on visual symbols and images as language elements. Visual communication is used with children with autism to support learning, participation, and independence [1].

figure 1. Hand-made visual communication tools

figure 2. Examples of picture cards found in classrooms

In this paper, we present the design of Mocotos, mobile communications tools for children with special needs. We first describe our formative research and design methods. We then review the current tools for augmentative and visual communication. We then describe a prototype Mocoto. Finally we conclude with a discussion of work currently in progress and future plans.

Design Methods

We have taken a mixed method approach to designing the Mocoto prototypes. We build upon two major prior studies of caregivers of children with autism [3,4] to understand the breadth of tools currently in use. Although these studies were not specifically focused on visual communications tools, they provided us a broad understanding of the classroom and home environments in which these tools might be deployed. We also consulted the literature with regard to the state of the art in analog and digital assistive technologies and augmentative communications tools.

We supplemented this background work with a formative study specifically dedicated to visual communications tools. We consulted three experts in assistive technology and classroom management. We also visited nine special education classrooms at two sites in Southern California and interviewed ten experts and teachers at those sites in small groups or individually for approximately one hour each. These interviews and observations provided us detailed information about the requirements, constraints, and need for new mobile communications tools.

Tools for Visual Communication

Through our interviews and observations, we uncovered requirements and constraints that can be addressed through Mocotos. Perhaps the most important of these is the need for extreme flexibility and customization. Current analog visual communications tools vary greatly from classroom to classroom, and even from child to child. Each teacher we observed had customized her tools, from the shape and size to the organization and setup (figure 1). New tools must not only provide the added benefits afforded by digital technologies, such as automatic data logging, remote collaboration, and so on, they must also support flexibility and customization to be adopted by teachers in real classrooms. Further constraining the design space are the physical abilities and disabilities of the children who will use these tools. Many of the children we observed, in particular preschool aged, had only crude motor skills. Thus, some child users may not be able to accurately point to a small object on a display, while others lack the ability to press down rigid buttons. New technologies, such as the capacitive screens on many small touch-screen devices, provide new avenues for interaction.

We also explored the current state of the art in digital assistive technologies in classrooms. A consistent theme in our interviews, however, was the relative bulk and difficulty in handling these devices. Furthermore, the configuration and customization – or end-user programming – of these devices was hugely taxing. One expert in assistive technology reported that the programming for a single child for a few months of use can require 8 to 10 hours of work. These findings indicate a huge need for flexible and intuitive interfaces.

Visual communication tools take a variety of forms, from small single picture low-tech cards to advanced computational systems that perform text to speech

figure 3. Card used as a prompt

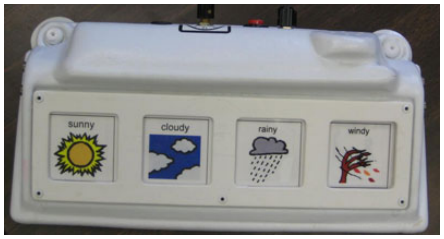

figure 4. Options to answer a question about today's weather

figure 5. A "wallet" carried by a child containing frequently used cards

figure 6. An oversized button providing mediated speech functionality

functionality. The most widely used augmentative visual communication tools in the classrooms we observed are simple laminated pictures with Velcro backs depicting various objects or activities or concepts (figure 2). Based on our observations, we defined four categories of use for these tools:

- *Prompting:* During a specific task, the teacher may use a card as a supplementary visual prompt. (figure 3)
- *Selection:* Options are presented to the child as cards when they must answer a question.(figure 4)
- *Basic Communication:* A child may carry a device or collection of cards to communicate needs. A method for this type of interaction is described in [2].(figure 5)
- *Mediated Speech:* A visual card can be placed on an electronic audio device, allowing the child to choose the image and play a recording.(figure 6)

There is an entire ecosystem of material, devices and methods surrounding these analog methods for visual communication. Unfortunately, there are many problems inherent with the cards themselves. Teachers and caregivers struggle to manage the large number (typically in the hundreds) of cards being used. Likewise, they must invest significant effort to create the cards. Commercial vendors, such as BoardMaker™ sell sets of pre-fabricated cards, but these are not flexible enough to meet the needs of many of the caregivers we observed, who instead often opted to create custom cards from physical artifacts or digital imagery. Finally, these paper-based visual tools often have to be used in conjunction with a variety of devices and for a variety of activities. Each device serves a different purpose, operates differently, and often requires custom configuration.

There are several advanced digital technologies for augmentative communication (e.g. GoTalk, Tango, Dynavox, Activity Pad). The teachers and experts we interviewed listed a variety of concerns with these technologies, from usability to complexity to lack of flexibility. Furthermore, these devices typically require professional training and expertise, making it difficult for many parents to use them at home. They also carry price tags that most lower and middle class families cannot afford. We can reduce the barrier to entry for these technologies by using familiar platforms, like the mobile phone, and simple end user programming to create flexible but customized interfaces.

A prototype Mocoto

Given the prevalence of low-tech choice-board tools, it was a natural selection for our first prototype Mocoto. The current prototype includes a portable device not much larger than popular cell phones, the Nokia N800 (figure 7). Both children and adults can use the touch screen on the device for interactions. Adult caregivers can also make use of desktop software to "program" the devices. The primary interface metaphor consists of virtual cards. The Mocoto comes preinstalled with a comprehensive library of cards. Users can also add custom cards to the interface by taking pictures, scanning in materials, or creating digital images. Each card includes both a name and other customizable meta-data, which enables easy categorization, searching and management of the cards. The model for the desktop software is to provide a rich interface for various programming and customization activities. The

figure 7. Mocoto prototype on the Nokia N800

device itself is then reserved for rapid access to the library of virtual cards and real-time and ad hoc setup of new activities. This scaffolding on and off the desktop supports pre-planning as well as handling dynamic activities that occur daily in all classrooms.

The prototype system is flexible enough to handle multiple functions currently supported by different devices inside the classroom. Use of custom audio cues for the cards, flexible layout of the cards on the screen - both in terms of size and number, and custom action assignment to input enables support of a variety of types of communication from highly structured communication during an educational activity to unstructured spontaneous utterances.

CONCLUSIONS AND FUTURE WORK

The design of assistive technology for children with special needs presents numerous challenges. The nature of the target audience places constraints on the physical and visual presentation of an assistive system. At the same time, the dynamic atmosphere of a classroom calls for the flexibility of this presentation. This flexibility must be designed in a way that can easily and quickly be managed by caregivers. This flexibility should open new opportunities for the use of augmentative visual communication systems, for instance consistent use across environments (e.g., home and school).

Our preliminary results indicate that a new class of mobile communications tools are necessary for to reach the full potential of augmentative and visual communications. We are continuing to prototype new Mocoto designs in collaboration with teachers, specialists and caregivers of children with special needs.

We are also interested in exploring new approaches that move away from the traditional structures of communication tools and take advantage of the advanced capabilities of current mobile devices. For example, we are currently examining the potential for introducing machine learning capabilities to provide intelligent support and real-time suggestions for communications options.

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