
The Baby Connect System: Facilitating Long Distance Interaction Between Infants and Adults

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Abstract

The Baby Connect System is designed to facilitate new methods of long distance interactions between infants and adult family members. Baby Connect allows adult family members to control physical changes of actuated objects attached to a mobile installed above an infant's crib by manipulating a tangible user interface in a remote location. The adult family member is able to view the infant's reaction to these environmental changes via a live video feed displayed on the adult's tangible user interface. This paper describes the current implementation of the Baby Connect system and explores possible future iterations and evaluation methodology.

Keywords

Tangible user interfaces, infants, interaction, communication, evaluation, puffer fish

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. See [3] for help using the ACM Classification system.

General Terms

Design, HCI, INFO 262: Tangible User Interfaces final paper

Introduction

Newborn babies are very important additions to families and cause much excitement when they are born. However, many family members live great distances from one another and are not able to interact with the new baby as much as they might like to. Traditional forms of remote communication such as phone calls, email, letter writing, instant messaging, or VoIP services (e.g. Skype) do not do a good job of facilitating interactions between infants and adults because infants are unable to use this technology as it was designed. The *Baby Connect* system facilitates long distance interaction between babies and adults by giving adults control over components integrated into the infant's crib environment by taking advantage the physical affordances of a crib mobile.

The Baby Connect System

The notable technical components in the Baby Connect system are:

- Force-Sensitive Resistors (FSRs),
- Potentiometer
- DC brushless fans
- Textiles
- DC stepper motor

- Control electronics
- Video webcam
- Video display

These components are implemented at two points of interaction which I will describe as the infant end and the adult end.

The infant end takes the form of a mobile attached to the Infant's crib. Like other mobiles it has dangling figurines and the spinning capabilities.

This mobile is controlled remotely by a tangeable user interface on the Adult end which I will refer to as the Baby Connect Controller.

The Baby Connect Mobile

On the infant end, the Baby Connect mobile is installed above the infant's crib and was designed with similar functionality and physical affordances to more traditional mobiles, but has additional features with outputs controlled by the Adult user and containing integrated video monitoring technology. Rotation of the mobile arms is actuated by a stepper motor and controlled by a stepper motor driver. The mobile figurines are four puffer fish in the initial prototype implementation. Each puffer fish has its own unique textile is inflated by a dedicated 12 Volt DC brushless fan. A webcam is affixed to the stationary frame of the mobile to record a live video feed of the infant to be displayed on the Baby Connect controller.



Figure 1. Drawing of the crib mobile on the infant end of Baby Connect.



Figure 2. Puffer fish prototype attached to the Baby Connect mobile on the infant end of the Baby Connect system.

The Baby Connect Controller

The Baby Connect controller is an intuitive tangible user interface that resides in the Adult family member's home. The controller is designed with the intent to be useable without any knowledge of computers or special technical capabilities so it can be used by family members with a range of technical capabilities, the focus is on interaction with the infant. The adult can manipulate various elements of the interface to control analogous components on the Baby Connect mobile to stimulate physical changes in the infant's visual environment intended to draw a reaction out of the infant. The Adult can then view the infant's reactions on the video display which is also located on the controller.

The controller consists of layered top and bottom panels. The top panel contains the video display and is designed to remain stationary relative to the user. The bottom panel contains four tangible fish elements. Each fish element consists of a Force-Sensitive Resistor (FSR) covered by a textile that corresponds to one of the puffer fish on the Baby Connect mobile installed on the infant's crib. A 12 volt DC brushless fan is activated to inflate a puffer fish on the Baby Connect mobile whenever the Adult family places pressure on the FSR by touching one of the corresponding fish elements. The top and bottom panels are connected to each other with a potentiometer, allowing the bottom panel to rotate relative to the stationary fixed panel within a limited range. The position of the potentiometer specifies the direction and speed of the stepper motor rotation on the Baby Connect mobile. The mid position is neutral and results in no rotation of the stepper motor. Rotation of the potentiometer in either direction

from the mid position specifies the stepper motor rotation direction with a speed proportional to the potentiometer's offset from mid position.



Figure 3. Prototype of the Baby Connect controller on the adult family member end of the Baby Connect system.

Related Work

The Baby Sense Environment [1] is an integrated system designed to enhance an infant's sensory-motor experience, to allow parents and relatives to remotely monitor infant's development, and to enable new types of interactions with other infants.

Both Baby Sense and Baby Connect systems have a mobile component and facilitate a means for remote relatives to participate in the infant's development. However Baby Connect constrains its focus to facilitating interaction between Adult family members in

interesting ways while the Baby Sense System is a more multifunctional system with a variety of goals.

There are several fundamental goals of the Baby Sense system which the Baby Connect system does not attempt to pursue:

- Baby Sense aims to sense an infant's movements inside of a crib.
- Baby Sense facilitates communication between infants.
- Data collection for researchers studying infant perception and cognition.

FUTURE WORK

Iterations and Improvements

There are numerous options to explore for inputs in the adult's tangible user interface, the use of different actuators to create interesting infant's physical environment that take advantage of all of the infant's senses, and novel communication mechanisms to facilitate communication from the infant to the adult.

Child Development Considerations

The Baby Sense System [1] pointed out the opportunity to use their system to learn about an infant's behavior and perception during the first 12 months of life. While the goal of Baby Connect is not to record data for the purposes of Child Development research, further exploration into the perceptual and sensing abilities of infants as they quickly develop would be helpful when deciding on features to explore in future iterations.

EVALUATION

Ultimately we would need to implement a study to evaluate the success and implications of the Baby Connect System.

Randomization and Sample Selection Considerations

When constructing an evaluation of Baby Connect, we must consider at which level to randomize my user group. Since there must be an infant involved in the unit of randomization, two paths seem most obvious.

1. Each adult baby pair is the base unit of measurement, allowing for multiple measurements within families with the baby being the common component.
2. Each family is the base unit, allowing for measurements across families.

Each of these approaches has its own advantages, and it may be worthwhile pursuing both levels. The first approach allows for comparison across different aged adult users within a common family context (e.g. adolescent cousins vs. elderly grandparents).

The second approach allows for comparison across different family situations which may provide interesting insights across cultures, family size and levels of distance distribution among families.

Comparing Design Elements

We may be able to gain insights to the successful components of different system versions and design characteristics by establishing different randomized control and test groups of users at the different inter-

family and cross family measurement units described above.

Quantitative Approaches

The electronic nature of the Baby Connect system allows us to gather quantitative data on use. Possible measurements include:

- Duration of system use
- Frequency of system use
- Comparison of feature use frequency (e.g. inflating fish vs. spinning mobile)
- Response of baby correlation to certain adult activities.

These quantitative measurements can give us interesting usage statistics across groups of users that we can sort based on parameters such as age, distance between residences, frequency of in person visits, system reliability, etc. These quantitative measurements may provide insights into user interest in specific features on the adult end.

It is more difficult to collect quantitative data for the infant end. As of now our only source of measurement is the movement on recorded video, which would be difficult and laborious to convert into data for quantitative analysis. To gather more quantitative data on the infant end we may have to implement sensing features similar to those in the Baby Sense system.

Qualitative Approaches

Qualitative methods have the potential to give us insights into the experience of using the Baby Connect system and how it is perceived to integrate into the Adult/Infant relationship, rather than pure usage statistics yielded quantitative methods. Possible methods include:

- Interview
- Observation
- Taxonomy
- User recorded logbooks
- Open ended surveys

The use of some of these qualitative methods provides the opportunity to augment the quantitative data with a user explanation, story, recounting of an experience or feelings. For example, a user study of the Baby Connect system could consist of gathering quantitative data on the system usage by each adult member of the family, but we could also ask each user to keep a logbook [2] documenting their experience using the Baby Connect system.

In addition to the logbook, each adult user would be asked to fill out an open ended questionnaire meant to collect index able information such as distance from the infant, frequency of in person visits and interactions with the infant. The questionnaire will also contain questions designed to learn about the relationship [2] with the baby before and after using the Baby Connect system as well as their interest in interacting with

infants using technology, or interacting with infants in general.

To better understand the intuitive use of the tangible user interface we can utilize methods such as interview and observation. Or we can use other less conventional methods like asking the user to give a stranger instruction on how to use the system, to draw a picture tutorial for the Baby Connect system, or asking the user to describe an interaction they wish they could implement on the Baby Connect system.

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Citations

[1] Weinberg, G., Fletcher, R. and Seum-Lim, G. The Baby Sense Environment: Enriching and Monitoring Infants' Experience and Communication. CHI (1998)

[2] Kaye, J.'J'. I Just Clicked to Say I Love You: Rich Evaluations of Minimal Communication *alt.chi, Ext. Abs. CHI 2006*