

E-PLAY

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ABSTRACT

E-Play is an electronic entertainer, pacifier, and communicator that meets needs of very small children, from infancy to preschool, is robust and simple to control, and is activated by touch only. Children choose activities by touching a picture, thus it is a natural design for use with kids having no computer experience. We have explored two types of content – purchased content (videos, games, etc.), and individualized content, customized by the child's parents. The device can contain more material than any single book, videotape, or CD-ROM and provides greater flexibility. E-play can provide a wireless communications link, opened by either the child's or the parent's initiative, or automatically in response to the child's actions.

We report here our observations of how children aged 8-50 months have learned and worked with this simplified interface, and what characteristics of their responses need to be anticipated in the interface software. We studied three small children as they activated the device options and interacted with its content. We report their apparent degree of understanding of the different computational concepts involved, such as hierarchies, and operational procedures.

1. INTRODUCTION

Human Computer Interaction has concentrated on designing interfaces for adults and children over the age of four. Kiosks were mainly implemented for public areas [1]. E-Play is intended to be a customized kiosk dedicated for children that could interact with it at home, or at day-cares. It can be configured as an educational toy although its content is more general, and can be designed by the child's own parents. This is in contrast with other educational toys like Curlybot [2] which are intended to teach the child specific concepts (e.g., mathematical or computational).

In this paper, we are interested in an interactive application for children below the age of four. We have imple-

mented an electronic device, based on currently available Panel PCs (e.g., from www.advantech.com) with flat touch-sensitive screen. Wireless Web tablets were already tested for family use at home [3]. However, these tablets were pen-based and not easy for children to use. Little children touch recognizable figures in a natural way. Therefore, in our case, touching the screen results in activating multimedia content that is stored in the device. Interactive pets have also been designed for kids (e.g. see work by Druin et al. [4] and Strommen and Alexander [5]). Nevertheless these pets seem not to be customized and cannot show the child the multimedia content that can be stored and played in E-Play.

As will be shown in Section 3, we have performed a series of tests with successful results and impressions. We first describe technically how E-Play is programmed and used (Section 2). A discussion of our results and the main contributions of our design are explained in Section 4. Finally we conclude and present directions for future research.

2. OVERVIEW OF THE DEVICE

E-Play is a personal computer that consists of a single flat panel display with a touch screen overlaid. It is small enough to be held in a child's lap or to be leaned on a couch.

We have implemented a prototype of the electronic device. The designer programs the starting screen with meaningful buttons (e.g., the faces of the future users of the device). The device is built as a tree, where the root is the starting screen and the first level of nodes corresponds to the potential users of the specific implementation. For each user, the designer builds a sub-tree which root is the node at the first level of the general tree designed for the whole device. This sub-tree's depth depends on the depth of the hierarchy that the designer chooses to present that user with. We call the application for a user "flat" when this sub-tree is of depth one. All the forms with their respective media content are accessible at the same level, from buttons that appear together on the same form. If the application for one user is hierarchical, *back* buttons are added to the forms to move from one level in the sub-tree to the level above. Moving up can also be achieved by touching the screen when a

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We prototyped EPlay with equipment and facilities provided by the Wolfson Family Charitable Trust. E-Play is patent pending.

movie is running during its active time. The movie closes and the screen for the next level appears.

Since little children can be very active, i.e., they will touch the screen as a sign of recognition of the person in the movie, or as a sign of excitement, we have programmed the touch screen to reside in one of two states: active or inactive. The buttons are always active. The movies are active for a very short period at the beginning. This period may enable an adult to change a movie if preferred. Then the movie enters a period of inactiveness. This time is the minimal time we would like the child to see the movie (to remain concentrated). From then on the movie enters the active period again. Any touch on the movie while it is active will stop the movie and will hide it, returning the child to the previous screen.

E-Play can be used either for one specific child, for several children in a family, or in a play group setting for multiple children. E-Play contains a large hard disk on which many movies, and family material can be stored and be accessed. The device can be customized for each family. Parents who own video cameras will be able to record movies of themselves reading stories to their children, singing songs, or talking to them. Then, they will be able to easily transfer the files to the hard disk of the device. The parents will choose from a menu the shapes to be presented to the child and can associate pictures with them.

The device may be connected in a wireless manner to create wireless phone communication between the child and his/her parents. The activation of the phone is natural as in the case of running a movie, i.e., by touching a corresponding button. Parent or for that matter any adult can initiate the link, given that appropriate security can be provided.

3. EXAMPLES OF USE

Currently we have developed three configurations: 1) for babies, 2) for little children (1-3 years old), and 3) for older children (3-5 years old). Each one of these versions was customized by the family of the child who tested the device. All of the three configurations were accessible from a main screen from which an adult user can choose how to run his child's implementation.

Our objectives were twofold: 1) test how children manage to interact with the device. This includes a) being able to operate the application, by activating and stopping the movies, b) understanding the meaning of a hierarchy and being able to browse it for example by touching a *back* button (this is in particular relevant for older children). 2) test whether the children like interacting with E-Play, i.e., whether they show interest and enthusiasm when they play with the device. In particular, we would like to test the children's reaction to their possibility of interacting with a device that was customized by their own parents and enables

them a broad range of media content. Finally, our aim was also to test how parents react to having such a device at their homes, while they can customize it in different configurations for different children in the same family.

3.1. Tests with Babies

The first test was performed with a baby of 8 months old. The baby had no video nor computer experience. E-Play was placed on a children's carpet and was surrounded by other toys. The baby was presented with a screen divided into only two areas, half of the screen was painted with green and the other half was yellow. The baby patted the screen, and she also remained with one hand on the screen activating it continuously. She reacted when the movie played, and laughed when she noticed that she caused the effects of playing a song and stopping it. It took 2 minutes for the baby to react to her own touching. The baby looked behind E-Play to check whether somebody is hidden there. After 5 minutes, the baby was able to activate a song, and listen to it without touching it again. At some point the baby was distracted by her parents with another toy, but when she heard the song playing from E-Play she came back to the device and kept interacting with it. She gave pleased expressions like laughing, and smiling.

A second test was done with the same baby four months later. The application shown in this test was customized with movies including her parents and pet. This implementation included a newer feature. We have programmed two timers which determine the period of time for which a movie is active or inactive. Touching a movie while it is inactive, does not interfere with the movie running, but prevents a child from sending mouse-clicks to the computer. Three buttons were implemented. The media files attached to these buttons were activated by the child touching the screen at the location of the button. These media files included: 1) the father reading a story to the child, 2) the mother playing a game with the baby, and 3) the pet of the family in activity.

The baby was placed in front of E-Play without other toys nearby. After the mother asked the baby who she would like to choose, the baby pointed at her mother and activated the corresponding movie. The movie showed the mother playing peekaboo. The baby touched the screen as a sign to discover her mother from beneath the towel used in the game. The baby was very happy when she recognized her parents talking to her from E-Play.

The baby recognized herself when she heard her voice from the device and was not actually looking at it. The baby expressed enthusiasm and happiness when she saw her mother playing with her through the device. The baby naturally touches the screen when she recognizes her parents or her pet in the screen. Having programmed the timer for active and inactive times was very useful. The baby managed

to stop the movie and chose the picture with the mother for a second time.

3.2. Tests with Little Children

A 1.5 years old child was presented with a customized application in which he could choose his father telling him a story, a song or his grandmother speaking to him. The child remained concentrated listening to his father's story-telling. The first test was done with a version of E-Play which did not distinguish between active and inactive screens. We learned to add this feature after trials with small children lead to many touches that were not intended to stop the movie but as a sign of recognition and excitement. During this first test when the song stopped at the end, the father told the child to touch the screen to get the former main screen. We have observed the child to be very happy when he recognizes his father and grandmother. He spoke the word "daddy" many times and even kissed the screen.

For the second experiments, we presented the boy with several groups of options on a theme. He could choose among episodes of a cartoon series, among short nursery song music videos, or among videos of himself and family members. There was no hierarchy – an adult selected the group for him. This application included the feature of disabling the screen for a determined period of time. This distinction actually prevented the child from running multiple tasks all at once.

The child was observed to interact with E-Play. He intentionally chose a song, played for a while, stopped it by touching the screen while it was active. The child danced in front of the E-Play.

3.3. Tests with Older Children

A four year old child tested the first application of E-Play. It was a flat and customized version. It did not include the active and inactive states. She listened to the story told by her father with concentration. Occasionally she put her hand on the screen, noticed that the story had stopped, leaving her at the main screen. She knew how to activate the story telling movie again by herself. After the story ended she got back to the main screen, looked at all the options and chose her father's picture again. After it ended for the second time, she chose a song from the main menu. We observed the child was very interested in listening to the movies available through E-Play.

A second trial was done with the same child five months later. The second implementation, oriented for older children, was implemented as a hierarchy of screens. The first screen resembles a graphical library. That is figurative buttons correspond to books and movie series known by the child. When the child touches one of the buttons programmed, she is presented with another screen similar to a table of

contents composed of buttons depicted with pictures representing the different chapters included in the specific application the child has chosen. When the child touches one of these buttons, a movie is run. This movie could be one episode in the series, one song in the library of songs, or one incident recorded on a family holiday.

The 4-year old child who tested the hierarchical implementation learned alone how to browse the hierarchy after only one session of interaction. She was very interested in the device, and independently played with it during long periods of time. After one session of interaction, she also understood the difference between touching the screen while the movie was active or inactive. She learned to wait and look at the movie for the period of inactiveness. She interacted very naturally by stopping applications, going back touching the back button and choosing intentionally what she wants. In one occasion, she chose one video showing her with a friend, she stopped it after a while and chose it again to see the beginning part twice. The child herself asked to play with E-Play, and was observed to enjoy E-Play more than with a regular television. E-Play is actually implemented as a customized TV and it is smaller and is easily placed for the children's convenience.

A parent of the smallest child said he would be happy to have his child use an E-Play, but not unsupervised until she is older. His impression (in agreement with our study of the videos) is that the familiar voices got the strongest reaction from his baby. A parent of the two older children was most impressed with the fact that they preferred E-Play to the TV for the same material (the songs and cartoons). He cautioned that the 4 year-old girl had previously had many hours of experience with children's video games, and was thus familiar with a mouse and the idea of clicking on symbols. The 1-2 year old boy had not had this experience.

4. DISCUSSION

The idea is new in three aspects. First, the device is able to store a large amount of stories, movies and other media files in its hard disk, making the device rich in content and easily accessible by the child himself by simple touch. Second, the device can be configured to enable a child to communicate with one of his parents in a very simple way avoiding the need to remember a phone number and the need to click the numbers in a regular phone. Third, the device can be customized by the family of the children that play with this device.

We can summarize the contributions of E-Play as follows:

1. **interface** — A child interacts with the device by touching its screen on different pictures. Touching pictures of familiar objects calls up actions child associates with these persons or things.

2. **customization** — The device is an interactive toy whose content can be decided upon by the parents of the child who plays with it.
3. **kiosks for babies and children** — The technology developed for kiosks has not been applied for small children. This technology enables a child to interact with this device in a very simple and natural way, i.e., by touch. Little children do not have to deal with mouse handling or clicking, learning to recognize text or to use a keyboard.
4. The hard disk of the device can be used to store large collections of media files that can be eventually activated by a child in a faster and easier way than is provided by a VCR, and can store many times more material than a single VCR cassette holds. Assuming secure distribution, movies could be downloaded over a cable TV network for the child's use.
5. Our device interface takes into consideration that children are interacting with it, as opposed to regular Personal Computers where there is a generic interface with which users can interact, i.e., mouse clicks or keyboard events. In our device, the mouse clicks (caught by the screen) have two states: active or inactive. In this way, our device causes the child to concentrate for a certain period of time on the movie chosen. Additionally, this computer interface is programmed in particular for children, who may touch the screen as signs of participation in the game and not as an intention to cause an event to the computer.
6. The device can serve as a platform to study children development. Observing children interacting with E-Play can teach us about the ways children perceive the effects resulting from actions they have performed by touching the screen. E-Play allows testing different interactive modes. These applications can be designed in particular ways to test the development of children of different ages. For example, in the current implementation, the hierarchy structure was chosen. The concept that the child learns is the meaning of a back button that will teach the child the meaning of "going back" to the previous screen. This button is widely used in all computers applications today. Nevertheless, it is not obvious that children understand what it means because they cannot read the word *back* and lacking computer experience this is not a trivial concept. Other structures that can be taught through the interaction with E-Play include matching forms, sets and subsets, learning relations (e.g., bigger, taller), learning colors, sounds, and words.
7. The interface of the device is adapted to the child's age. A flat interface is presented to the smaller chil-

dren. Hierarchical interfaces can be presented to older children that can understand the notion of hierarchies and navigate in a larger space.

5. CONCLUSIONS AND FUTURE WORK

E-Play was presented as an interactive device for very small children. The device presents the child with customized media content organized in a flat or hierarchical way. Children interact with E-Play naturally by touching the screen, and thus activating movies and stopping them. We have distinguished between two states in which the screen can be set: active and inactive. While the screen is inactive the movie keeps running but the touches of a child are not processed. This enables the child to remain concentrated for a pre-determined amount of time, while being able to touch the screen (without stopping the movie) as a sign of recognition and excitement. Tests we have performed showed that children learned to activate the program buttons very fast (only after a few minutes of interaction). Children were observed to be very happy and excited by interacting with E-Play.

We are currently studying an extension to E-Play. E-Play may be connected in a wireless manner to a server from which movies could be downloaded. This extension enables storage of even more data in a single computer that can be accessed by E-Play. Secondly, central servers with dedicated content will make the E-Plays disk-less, thus less expensive. The wireless link will prevent a child from being distracted by cables.

6. REFERENCES

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