A Contextual Learning Game for Toddlers Installed on an Interactive Display Attached to a Shopping Cart

Gerrit Kahl
DFKI GmbH
Stuhlsatzenhausweg 3
66123 Saarbrücken Germany
gerrit.kahl@dfki.de

Lübomira Spassova
DFKI GmbH
Stuhlsatzenhausweg 3
66123 Saarbrücken Germany
spassova@dfki.de

Karin Leichtenstern
Multimedia Concepts and Applications
University of Augsburg
86159 Augsburg, Germany
leichtenstern@informatik.uni-augsburg.de

Antonio Krüger
DFKI GmbH
Stuhlsatzenhausweg 3
66123 Saarbrücken Germany
krueger@dfki.de

Johannes Schöning
DFKI GmbH
Stuhlsatzenhausweg 3
66123 Saarbrücken Germany
johannes.schoening@dfki.de

UbiComp 2009, Sep 30 – Oct 3, 2009, Orlando, FL, USA

Abstract

Bored toddlers (children at the age of 1-3) often cause stress for parents during shopping trips in supermarkets. Sitting in the front of the shopping cart, they often grouch or arrogate different articles such as sweets or toys. The reason for this behavior is often the lack of useful activities for kids during shopping of their parents. In this paper, a concept for contextual learning games is introduced by using an interactive display attached to the shopping cart's handle bar. With this game, we want to let toddlers participate in the shopping process to a certain degree without annoying their parents. Using RFID technology, the shopping carts are able to detect the articles and products inside. These items are reflected in the game played by the toddlers. We are interested in up to which extent the integration of real world items in the game can provide a meaningful learning experience and also the needed distraction from sweets or toys. As a result, we expect parents to be more relaxed while their children pursue a useful experience.

Introduction & Related Work

Shopping with toddlers, especially young toddlers can sometimes be irritating and very stressful for their parents. In the case of parents and toddlers shopping together, particularly in a supermarket setting, many parents often have to deal with situations in which the toddlers want to a have a special product such as sweets or toys [5]. It is interesting to see that according to Ebster et al. the influence children wield over their parents' purchase decisions at the point of sale is often grossly underestimated by their parents [5]. Lindstrom [10] estimates that children at the age between 8 and 14 years spend and cause about approximately $1.2 trillion worth of sales worldwide (note that our target group is rather younger, so the volume toddlers "spend" will be smaller). In the HCI community as well as in the Ubicomp community, lots of research has been conducted to investigate the effects of advertisement on young children [6] as well as on the interaction with small interactive (mobile) displays. Brand and Greenberg [2] investigated the effect of advertisement in a classroom and Adler et al. [1] present a good overview on that research field. Ebster [5] suggests that the best way of keeping toddlers quite is to distract them from the shopping process. While this can be done by simply showing a colorful comic movie on the display of a shopping cart, we are interested in designing games for interactive displays attached to the shopping cart handle bar that let toddlers still participate in the shopping process to a certain degree without requiring too much attention by their parents. An example of such a display attached to a shopping cart can be seen in figure 1. We try to lead the toddler's attention between the real world and some games with real world items on the interactive shopping cart display. While lots of research in the

Figure 1: The interactive shopping card attached to the handle bar of the intelligent shopping car.

Ubicomp domain was conducted on how software and hardware for kids differ from software and hardware fro adults, the interaction of toddlers with small (7 inch) interactive displays has not been considered so far. Most research done up to date has focused on the design of classical educational software [6] and not on how toddlers can be involved in learning games in the context of real world objects and activities. The Parc Tabs [14] were among the first interactive small

displays introduced by Want et al. Following the idea of interactive, mobile displays the Tuister [3] or the Display Cube [8] were some of the first projects investigating embedded displays in real world objects. The work of Leichtenstern et al. [9] explored the role of the Display Cube in social learning software and the integration of the Display Cube as interaction and presentation device. Similar to the display system attached to our shopping cart are the stationary office door displays of the Hermes system by Cheverst [4]. Recently, Merrill et al. presented the Siftables [11], which are small interactive computers with a display, speaker, wireless communication and motion sensors.

The remainder of the paper is structured as follows: First, the scenario is described in section 2. Next, we describe and discuss the design challenges when developing interactive games for toddlers. Section 4 presents our idea of a contextual learning game. Finally, section 5 provides an overview of the used hardware followed by some concluding remarks.

Scenario

Susan Meyer is a 32-years-old bank clerk. She is a loving wife and mother of a 2-year-old boy named Sam. On ordinary days, Susan has a lot of stress at her workplace. After seven hours of hard work, she picks up Sam from the day nursery. This is the time when Susan's actual stress often starts because she has to deal with the daily tasks of a housewife such as shopping. In these situations, Sam can become a tease. He is often tired and bored and starts grouching. Sometimes Sam even starts crying or doing nonsense. Then, Susan wishes to find ways to overcame this stress. With our concept, we can help Susan to cope with such situations. The instrumented shopping cart detects all goods Susan has inserted. This information can be used as input for different contextual learning games, which are displayed on the cart's touch-sensitive screen. Now, using our concept, Susan can enter the store and place Sam in the toddler's seat of the instrumented shopping cart. Then, she can start her shopping while Sam is calm interacting with hands-on learning software displayed on the cart's screen. Normally, Susan buys different healthy fruits and vegetables such as bananas or apples. Once Susan has inserted a banana in the shopping cart, different articles appear on the screen in front of Sam. The screen shows a picture of a banana but also pictures of other articles such as an apple or a pizza (see figure 2 (left)). Now, Sam has to select the correct picture by simply touching it. As a feedback, a smiley is displayed which represents the correct or wrong response to the selection (see figure 3). This contextual learning game is considered to train a toddler's mapping skills of real and virtual objects. Other possible game types are illustrated in figure 2 (center, right). The example illustrates the potential of contextual learning games. They can hands-on train toddlers' skills and knowledge. Another example is *Memory*. Some of the articles in the shopping cart are displayed as cards, which have been turned over. The task of Sam is to find the correct pairs. In this application, Sam's memory skills can be trained. Overall, we think that contextual learning games on instrumented shopping carts support a promising novel platform for human computer interaction. However, several design challenges are raised.

Design Challenges

Several design challenges come up when developing user interfaces for toddlers. The challenges can be

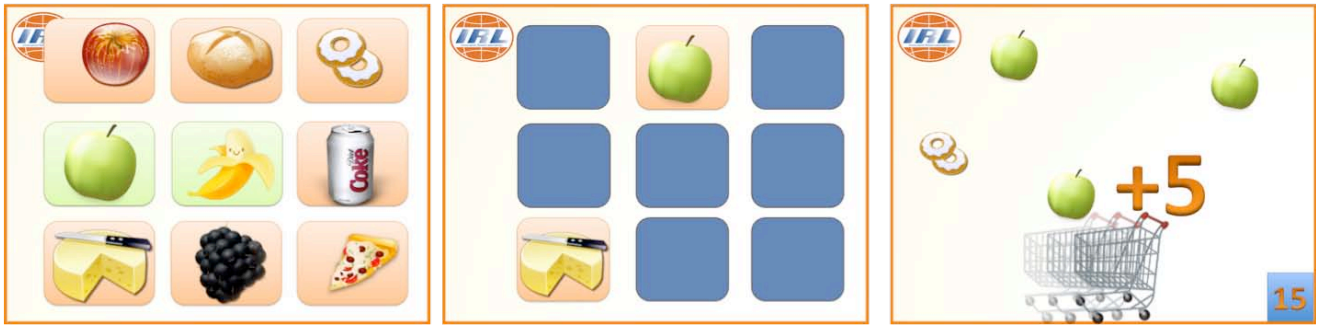

Figure 2: Example for contextual learning games (from left to right): "What have we brought so far?" (game concept described in the scenario), Memory with "real world items" and "Get the apple" (the toddlers have to collect as many apples as they can that fall down by moving the small shopping card from left to right).

summarized in the following two categories: toddlers' skills and design process issues.

Toddlers' Skills

The first design challenge is the consideration of the toddlers' skills. As people develop from infants to adults, their abilities increase over time [7][12][13]. Abilities can be divided into:

- Cognitive Skills and
- Physical Skills.

Toddlers' cognitive skills are often not as trained as those of older children. Hence, the interface designers must consider several aspects. For example, the required memory load must be kept as low as possible, e.g. by reducing the number of displayed items. Another aspect concerns the perception and concentrativeness of toddlers. Toddlers' response time is lower, than that of older children, which causes longer interaction times. Thus, interface designers have to provide clear and easy to recognize information to support the toddlers' perception and reduce response times. To increase the children's concentrativeness, the user interface has to be easy to use but at the same time absorbing to keep the concentration of the children. A further cognitive aspect affects the lack of toddlers' literacy skills. Accordingly, user interfaces have to provide widgets with icons instead of text. These icons must indispensably follow toddlers' knowledge to assure the correct interpretation of an icon's meaning. For example, different expressions of a smiley can mean the positive or negative responds to an interaction. The question is whether children at age of two or three can understand this feedback.

Apart from toddlers' cognitive skills, physical skills such as motor skills must also be considered. A lack of advanced motor skills can cause problems when interacting with widget displayed on the screen. For example, trained motor skills are required for the correct positioning of a widgets. Thus, interface designer should provide interactions which require less motor skills such as simple clicks on large widgets and easy to perform drag and drop operations.

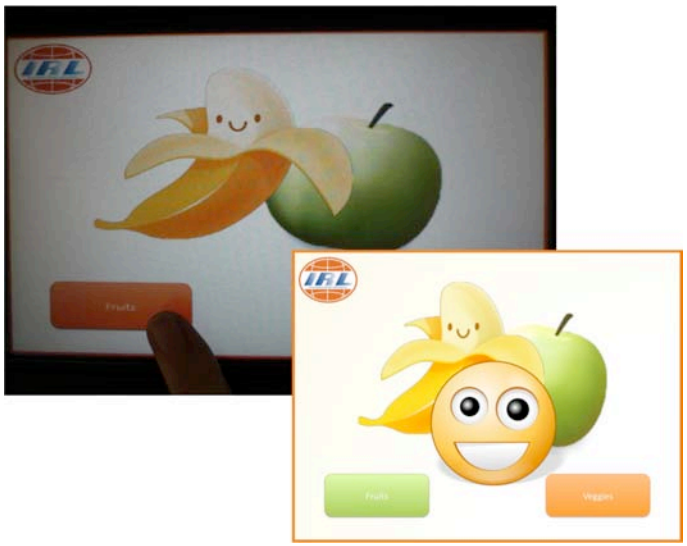

Figure 3: A kid interacting with the shopping card: "What's in? Fruits or veggies?"

Design Process

The user-centered development requires test with real users in the different phases of the development process. Hence, children at the age of two or three years are required to investigate user interfaces. We consider problems in recruiting users for several studies. Whenever the target group is very restricted to different characteristics, such as age it is time-consuming to find and recruit enough users to run evaluations. When conducting user studies with toddlers, even more challenges emerge. In our described scenario, toddlers are tired and grouchy when interacting with the applications. Thus, we require toddlers with a defined behavior, which can often not be artificially aroused. Another issue concerns the execution of applied tasks. Toddlers might not be disposed to follow the evaluator's instructions. Hence, controlled studies without any biases can often not be performed. Apart from that, several evaluation techniques become unfeasible if user studies are conducted with toddlers. Subjective methods such as interviews or questionnaires cannot be used anymore. Another example is the *thinking aloud method* which is not feasible because of the toddlers' faculty of speech. Accordingly, toddlers' skills exclude any approved usability evaluation technique. Interface designers can only conduct observations to investigate toddlers' behavior. The lack of subjective methods poses a great challenge for the interpretation of the objective data.

Contextual Learning Games

The described design challenges must be considered when developing user interfaces for toddlers. In this section, we describe the consideration of the aspects when developing a contextual learning game for toddlers. Our shopping cart provides a touch-sensitive display, which enables direct and easy to use interactions such as the selection of items via touching. Moreover, the screen can be used for drag and drop operations. These interactions meet aspects of the toddlers' motor skills. To support their cognitive skills, we reduce the number of displayed items on the screen and use icons to meet toddlers' lack of literacy skills. On the screen, we display large and easy to interpret widgets, which also support the toddlers' cognitive and physical skills. Apart from that, another important aspect of our concept is the combination of the real and virtual world, which is considered to support toddlers' mapping skills and meet the toddlers' knowledge. Toddlers can map real objects of a supermarket such as

a banana in the shopping cart to a widget displayed on the screen. Accordingly, the combination of the two worlds can help toddlers to interpret and relate real aspect to virtual information. Our approach of an instrumented shopping cart will be evaluated with real users in field studies. Thus, we do not have the problem of the recruiting of users because we conduct the studies in real settings of a supermarket. Moreover, the conduction of studies can be performed under a real contextual setting. We can find toddlers and parents in the required mood as described in our scenario. Thus, the results of our studies can provide valuable data to enable correct interpretation of lab studies.

Setup and Implementation

As an application platform for the toddler games introduced in this paper, we decided to use the instrumented shopping cart developed at the Innovative Retail Lab (IRL). The handle of this shopping cart is fitted with a 7-inch touch screen, a finger print scanner and a single button (see figure 4). In a current shopping cart application, the touch screen is used to display the customer's shopping list and information about products placed in the cart. In order to be able to display personal information, such as a shopping list, customers have to enroll their fingers using the finger print sensor. The integrated button is designed to be used for switching back to an application selection view ("home" button). Additionally, the cart is instrumented with two RFID antennas and corresponding tag readers. One of the readers recognizes passive RFID tags placed below the flooring of an instrumented supermarket (which is simulated in the ABC (blinded for review)) and thus enables an indoor tracking of the shopping cart. Based on this location detection, the customer can

Figure 4: The intelligent shopping card: The handle of this shopping cart is fitted with a 7 inch touch screen, a finger print scanner and a single button (photograph taken from the back, left). An RFID antenna is placed under the product basket to recognize which products are placed inside the cart (from below, right).

be navigated to products he or she is searching for. The second RFID antenna is placed under the product basket and is used to recognize which products are placed inside the cart. For this purpose, the products have to be fitted with passive RFID tags. Once a product is recognized in the basket, information about it is displayed on the integrated touch screen and the corresponding shopping list entry is checked. Currently, our system utilizes the Feig high frequency readers and tags[1]. All system components are connected to a computer, which is also integrated in the shopping cart. In the current prototype of the instrumented shopping cart, the touch screen is integrated in the handle in such a way that the customer pushing the cart can comfortably see the displayed content. For children sitting in the shopping cart, this screen orientation is of

[1] http://www.feig.de/index.php?lang=en

course unsuitable. Hence, in order to enable children interaction with the screen, the handle has to be redesigned so that its orientation can easily be changed or an extra screen is attached. In this way, the grownup customers can use the assistance applications that help them manage their shopping and if they need distraction for their toddlers, parents can rotate the display towards their children sitting in the trolley and start an appropriate game.

A second challenge that has to be addressed is the childproofness of the application. The toddlers should not be able to manipulate the application data of their parents. Accidentally changed or deleted customer settings would be an annoyance. Therefore, the application should offer different grades of permission rights. Obviously, it would be appropriate to use the already integrated finger print sensor in order to manage access rights to different applications. Once a toddler game is started, the customer will have to enroll his or her finger to get the right to switch to another application. In this way, an accidental misuse of the application can be avoided.

Conclusion and Future Work

We have presented a concept for a contextual learning gaming designed for toddlers using an interactive display attached to a shopping cart handle bar. We present design challenges and different sorts of games that can be played by the toddlers to let them participate in the shopping process to a certain degree without annoying their parents. In addition, we present a hardware solution for the realizing of such interactive shopping cart games and show design challenges for the hardware setup as well.

Obviously, the next step is running some evaluations with parents and toddlers. We already had some young parents involved in the design process. They gave us very promising feedback and stated that they would love to have such an application. They really liked the idea of reflecting real world items in the games instead of just showing "standard comics". In their opinion this would be an interesting balance between distracting their kids and involving them in the shopping process by creating a meaningful in-context learning experience.

References

[1] C. Atkin. Effects of television advertising on children. Children and the faces of television: Teaching, violence, selling, pages 287–305, 1980.

[2] J. Brand and B. Greenberg. Commercials in the Classroom: The Impact of Channel One Advertising. Journal of Advertising Research, 34(1), 1994.

[3] A. Butz, M. Groß, and A. Krüger. Tuister: a tangible ui for hierarchical structures. In Proceedings of the 9th international conference on Intelligent user interfaces, pages 223–225. ACM New York, NY, USA, 2004.

[4] K. Cheverst, D. Fitton, and A. Dix. Exploring the evolution of office door displays. Public and Situated Displays: Social and Interactional aspects of shared display technologies, page 141, 2003.

[5] C. Ebster, U. Wagner, and D. Neumüller. Children's Influence on In-store Purchases. Journal of Retailing and Consumer Services, 26(2):145–154, 3009.

[6] M. Helander, T. Landauer, and P. Prabhu. Handbook of human-computer interaction. Elsevier Science Inc. New York, NY, USA, 1997.

[7] R. Kail. Developmental change in speed of processing during childhood and adolescence. Psychol Bull, 109(3): 490–501, 1991.

[8] M. Kranz, D. Schmidt, P. Holleis, and A. Schmidt. A Display Cube as a Tangible User Interface. In In Adjunct Proceedings of the Seventh Internation Conference on Ubiquitous Computing, 2005.

[9] K. Leichtenstern, M. Kranz, P. Holleis, E. Lösch, and E. Andre. A tangible user interface as interaction and presentation device to a social learning software. In Fourth International Conference on Networked Sensing Systems (INSS '07), 2007.

[10] M. Lindstrom. Branding is no longer child's play! Journal of Consumer Marketing, 21(3):175–182, 2004.

[11] D. Merrill, J. Kalanithi, and P. Maes. Siftables: towards sensor network user interfaces. In Proceedings of the 1st international conference on Tangible and embedded interaction, pages 75–78. ACM New York, NY, USA, 2007.

[12] L. Miller and P. Vernon. Developmental changes in speed of information processing in young children. Developmental Psychology, 33(3):549–554, 1997.

[13] J. Thomas. Acquisition of Motor Skills: Information Processing Differences between Children and Adults. Research Quarterly, 51(1):158–73, 1980.

[14] R. Want, B. Schilit, N. Adams, R. Gold, K. Petersen, D. Goldberg, J. Ellis, and M. Weiser. The PARCTAB ubiquitous computing experiment. KLUWER INTERNATIONAL SERIES IN ENGINEERING AND COMPUTER SCIENCE, pages 45–97, 1996.