A Novel Approach to Interactive Playgrounds: the Interactive Slide Project

Joan Soler-Adillon
Department of Communication Studies
Universitat Pompeu Fabra
c. Roc Boronat, 138
08018 Barcelona
+34 93 5421238
joan.soler@upf.edu

Jaume Ferrer
Mediacciones
Open University of Catalonia
Av. Tibidabo 39-43
08035 Barcelona
jaume@enlloc.org

Narcís Parés
Institute for Audiovisual Studies
Universitat Pompeu Fabra
c. Roc Boronat, 138
08018 Barcelona
+34 93 5422631
npares@iua.upf.edu

ABSTRACT

The incipient research on interactive playgrounds is a promising field that can enhance in many ways growth, health and education of children and youngsters. In this paper, we present a novel approach to interactive playgrounds by describing the physical and interaction design of a new platform: the Interactive Slide. We concentrate on the main design issues and relate the acceptance of this platform; specifically through two applications that we have designed for it: one for children 4 to 8 years and a second for youngsters 10 to 14. This platform can provide a fertile ground for creative, leisure and educational applications and experiences. However, our main focus is on countering lack of physical activity and lack of socialization in children, which are important issues in all developed countries (and some underdeveloped ones) and especially important in Europe because of their accelerated pace of incidence.

Categories and Subject Descriptors

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. K4.m Computing Milieux: Computers and Society: Miscellaneous

General Terms

Design, Experimentation, Human Factors.

Keywords

Full-body Interaction, Playgrounds, Physical Activity, Socialization, Interaction Design, Exertion Interfaces.

1. INTRODUCTION

Huizinga [8] said, “Play is older than culture” and “[play] is at the very centre of what makes us humans”. The social view of play in the past century as a useless activity, mainly belonging to children has evolved into the current contemporary view in our society as leisure activities that can “fill our time when we are not at work”. This evolution is a first step towards what researchers from many areas –sociology, psychology, anthropology, etc. – have agreed upon for a long time already: that play is an essential activity for human development at all ages.

Our field of interaction design and children must also evolve. We must be able to make full use of play strategies and play structures in our research without having to justify them always behind some educational strategy or specific content teaching. Play is important by itself, as long as it is a meaningful experience for those playing.

Playgrounds –as spaces for children and youngsters to play in– “play” a very important role in activities that are of great importance in public health; for example, in social interaction and physical activity. Traditional playgrounds have been very successful in this for many years. However, in our modern technological society these playgrounds have become in many aspects outdated and our children and youngsters prefer to stay at home making use of audiovisual and interactive technologies that have become readily available, such as: television, computer games and videogame consoles, chatting applications, the Internet, etc. [3] (page 23). Apparently this is one of the reasons why the lack of physical activity in European children is a worrying issue, growing at a very fast pace and that is already motivating specific policies by the EC [3] (Foreword, page viii). Because of this, in spite of their incredible potential for our society, interactive media have become an important health threat for our youngsters.

This is why initiatives such as the Centre for Playware in Denmark [4, 10] become so important. This centre focuses essentially on “the interdisciplinary research field that deals with digital products aimed at creating play and playful experiences with users of any age”. This can help in making the social view of play evolve further as well as can directly help our children. Other research groups are also contributing to this field. For example the Sonic Studio of the Interactive Institute in Sweeden with their “DigiWall” project [9]. Another example is the Lalalab group from University of Valencia in Spain with projects such as “Zona de Recreo” (“Play Zone”) and “Hybrid Playground” [5, 6]. The projects “Reactive Playgrounds” and the “Space Explorers for Kids” from the MIT Media Lab groups Lifelong Kindergarten and Smart Cities respectively, are other very interesting efforts from the USA [20, 21].

Another set of efforts that directly link to this field are those related to exertion interfaces, a term coined by Mueller, Agamanolis and Picard at the MIT Media Lab and Media Lab Europe [11, 12, 13]. According to their view, not only do exertion interfaces promote physical activity, but also this physical activity seems to create stronger and faster bonds between users of an interactive experience, hence promoting socialization between users.

There have been also some initiatives from industry in this direction such as: Kopan (Denmark) with their collaboration with the “Playware” tiles initiative; Lappset (Finland) with their “SmartUs” technology; or Playdale (UK) with their “i-play” system [7].

There are many other interaction design and children initiatives that can be related to playground-like structures or proposals, such as those within the UK Interdisciplinary Research Collaboration project called “Equator” (http://www.equator.ac.uk/). However, they are not explicitly within the scope of the present research.

Our research is also centered on these efforts. We have been exploring the use of public space for developing full-body, multi-user interactive experiences in which children can have rich physical and social activity since 1998 [16, 14, 15, 17, 19, 24]. We approach it from the interactive communication standpoint to address the interests of current generations of children. Our will is to help in pulling them out of their homes to play with media that are inherent in their culture and that they know very well, albeit in a very different context.

This paper specifically focuses on the design criteria that have led us to obtain a new platform: the Interactive Slide (Pat. Pend. UPF) [18]. We will describe both the physical and technical design of the Interactive Slide and the interaction design of two applications specifically conceived for it.

2. THE INTERACTIVE SLIDE IDEA

When approaching the notion of interactive playgrounds we can distinguish between two possibilities: we can try to imagine completely new playground structures based on new configurations of interactive media, or we can investigate the possibilities of already existing structures to evolve and incorporate interactive media. Both options are obviously valid and in the past, we have designed and developed some completely new playground-like installations with interesting results [16, 14, 15, 17].

In this case, however, we wanted to explore traditional play structures to see whether they could help in achieving a fast approach of the potential users to them. The idea being that they are already well-known structures to children. In other words, we want to exploit the cultural and social naturalness provided by the familiarity of a structure that has been around children culture for many generations.

The slide structure provided very interesting characteristics to this end. On the one hand, the naturalness of this play structure comes from ergonomics, i.e. it is a natural play activity to slide down a ramp in a sitting position and is therefore a culturally diverse and ethnically broad activity. Additionally, it makes a very interesting use of gravity, not only because one must climb up to be able to slide down, but also because one may try to stop half way down, hang from the top edge, or slide down in many different positions (feet first, head first, etc.). This is also good for enhancing physical activity, one of the main goals we are pursuing.

A slide also provides a context for sharing the experience with others, especially if the slide is wide: children can slide down together; a child at the top can hold the other while the second hangs down the ramp; etc. This made the slide a potentially multi-user and flexible structure unlike, for example, a swing or a seesaw.

Finally and very important, the sliding surface of a slide was clearly a surface apt for projecting computer-generated feedback and a controlled area for detecting user activity. This made it extremely adequate, as a traditional structure, to augment it with interactive media in a relatively straightforward manner.

3. CONFIGURATION

The basic idea was to determine a shape for the slide to make it capable of holding a reasonable amount of children simultaneously, while keeping it within a relatively manageable size. We agreed that a 4m wide and 3m long sliding surface would be large enough to hold between four and eight children.

From the image generation and projection point of view, this surface would also be large enough for the projection to work with clear graphics but without it feeling pixelated.

Although when first thinking about a playground one probably thinks about outdoors activity, this is not necessarily the case. The type of augmentation applied to our Interactive Slide platform obviously restricts its use to an indoor setup due to current projection technologies. However, there are many contexts for indoor use, such as school gyms, indoors leisure parks and playgrounds, culture and social centers and societies, etc.

At this point, we started to define the shape of the slide and how to adapt technology on, or around, it.

3.1 Interactive Technology

We decided to use a projector and an artificial vision system at a certain distance in front of the slide. With a 4x3m surface, we could use a projector with relatively angular lens to be able to put it at a reasonable height and distance. Moreover, the support that holds the projector can also hold a small camera to look upon the sliding surface (Figure 1).

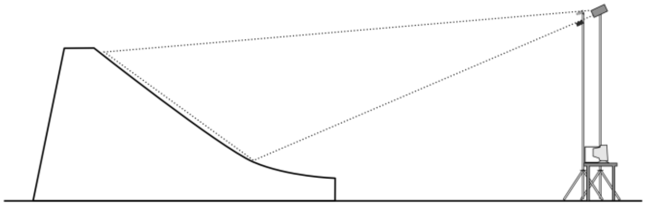

Figure 1: Basic configuration of projection and camera with respect to slide.

It is important to try not to project too obliquely because then the projector needs a very good keystone compensation control, which not all of them have. Such a position is also convenient for the camera to avoid having a large deformation of the captured image.

Although we are using front projection, the bodies of the children are always in contact with, or very close to the slide. Therefore, the shadows casted by the bodies of the children do not interfere in the correct visualization of the images because they fall right under their bodies.

We decided to use an artificial vision system based on infrared light. This way we did not depend on the brightness of the projected image to achieve a good vision of the users, or on external visible lighting that would disturb the correct visualization of the projected images by the users. These AV systems are commonly used in many interactive installations nowadays.

The system is therefore augmenting the traditional slide structure with the interactive technology. It becomes a mixed reality experience where the physicality of the slide ceases to be the only identity of the play structure and where, symmetrically, the virtuality of the projected environments is dependent on the physical properties of the slide. This actually defines a new medium in which we can create new experiences with very particular specificities based on how the slide activity depends on gravity.

3.2 Structure and Safety Issues

The first idea was to construct the slide in wood to have a robust and smooth surface. This would allow for a very clean projection as well as a very clean background for the artificial vision system. This imposed some practical issues such as how to install, uninstall and transport the slide. More important than these reasons, we had to contemplate safety issues to be able to set up the slide for children in public spaces.

On the one hand, a wooden slide with a specially defined shape would probably need to pass certification tests from official institutions or administration to accept it legally as a safe apparatus for children to play in. On the other, it was quite clear that any falls and hits could be more harmful on a hard surface than on a soft one.

Figure 2: The inflatable solution for the Interactive Slide

The solution we found was to use an inflatable slide (Figure 2); a structure that needs a constant flow of air to maintain the correct pressure to keep the structure up. It offered many advantages over the wooden version:

- It is a soft structure that is held up by an air cushion.
- It is a structure that can be compacted into a very small package compared to its full size when in operation.
- It can be set up in a very short time.
- There are already legal specifications that describe construction and deployment issues.

We found a company close to Barcelona (Tecnodimensión, S.L.) that has a lot of experience in constructing inflatable structures. In fact it is the only one in Spain, and one of the few in Europe, that can tag its structures with the CE symbol meaning it complies with all construction and functional specifications required by European laws. They became very interested on the project and helped us very much in prototyping the slide.

One important advantage of how we apply the interactive technology to the slide is that it does not physically interfere with any of the parts of the slide. In other words, we have had to do no structural changes to the certified slide, we have not needed to insert any sensors on its surface or have not had to change any of the materials. This is very important because it maintains the slide certification.

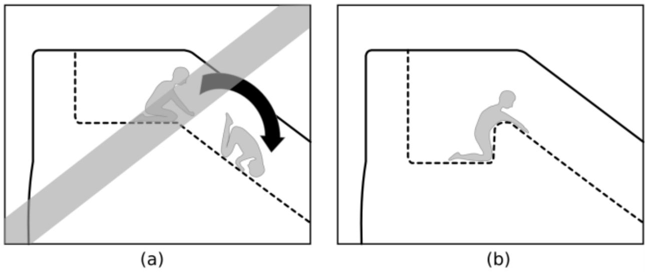

Figure 3: Safety design of the top of the Interactive Slide (lateral section view) considers unwanted falls (a) and provides good control over the interaction surface (b).

Since the slide must allow interaction on its surface from the top, we needed a shape that would provide good control to the users and prevent unwanted falls over the sliding surface. We solved this by defining the floor of the top of the slide at a lower level than the upper edge of the sliding surface. As shown in Figure 3a, having left the floor of the top part leveled with the upper edge, would have easily caused children to tip involuntarily over the edge. By lowering this floor around 50cm from the top edge (Figure 3b), users can kneel down and bend over the edge to interact with events occurring on the upper part of the sliding surface in a safe way.

In addition, we decided to place the staircase beside the surface of the slide, as opposed to the back, such that users could access it from the front of the slide. This would generate a fluid circulation of users and keep all the area that the children move in within the protective walls of the slide (Figure 2).

The whole slide, having a footprint of about 50m2 when inflated, can be folded into a package of 1.5m3 that weighs around 200Kg. This makes the huge slide very transportable to be able to install it easily at many different venues. The rest of equipment needed are the computer, the projector, the camera, the IR lighting and the inflating motor.

However, there were also some disadvantages to making it an inflatable slide rather than a solid structure. Now the sliding surface was not as smooth as in the wooden version. This is partially an inconvenience for the projection but notably a large one for the artificial vision system. The wrinkles generated on the surface by the children have imposed important constraints on our vision system, which we have nevertheless managed to overcome.

In its current configuration, the whole set up may be fully installed, calibrated, and ready for use in about thirty minutes.

Folding it up may take a little longer but it still proves to be an extremely flexible and easy to use platform.

It is important to note that we can design and develop myriad games and educational experiences for the surface of this slide without changing its underlying infrastructure. The challenge is therefore to design experiences that make a good and justified use of the slide structure and its specific use of gravity. In other words, taking this slide as an interactive communication medium we must find applications that show a good adequacy to this medium.

4. THE VIRTUAL MOSAIC: THE FIRST APPLICATION FOR THE INTERACTIVE SLIDE

We conceived the first application for small children ages 4 to 6 (maximum 8). The basic idea was to provide them with a creative environment in which to play with shape and color while at the same time doing some physical activity. We wanted it to be a collaborative activity to get children to socialize with others and to work together to achieve group results.

In our interaction design process, we followed the interaction-driven design strategy [16] that we have formalized and used in previous projects, and used a similar visual approach to the one we defined in the MEDIATE project [14]. This interaction-driven design strategy defines a framework to start designing from the attitude that we wish the users to have with respect to the application. In other words, instead of starting the design from a specific content (which would define a content-driven design strategy), we first decide what actions in the users will support the attitude we wish them to adopt, and it is not until later in the process that the content can emerge within the application. Based on this, we decided to provide children with the ability to work with geometric pieces and colors. For technical simplicity, we decided to fix the shape of the pieces to squares.

To exploit the notion of gravity in a very simple way, we decided to make the squares continuously fall down the surface of the slide. This sort of “rain” of squares gives a clear idea of what the slide is for (i.e. sliding down its surface) while at the same time it is already telling the children it is a “live” structure that can potentially interact with them (Figure 4a).

We made the squares only a black outline on the white background also to give the children the idea they could be colored “somehow”.

As the squares randomly appear at the top and slide down at different speeds, they collide with others on their way, to stop finally when reaching the bottom or when colliding with already static squares. This forms a monochrome mosaic of haphazard layers and columns of squares. To avoid having the whole surface completely filled up by this continuous flow of squares, we defined a maximum height that the mosaic can reach. When the deposited squares reach this height, the system forces the mosaic to lose its lower row. This makes the whole mosaic to drop down one level and, as time passes, it shows an ever-changing pattern.

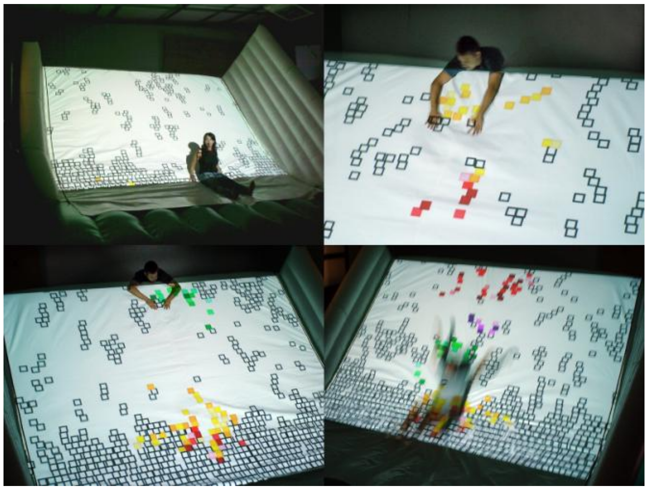

Figure 4: The Virtual Mosaic application: (left-right/top-bottom) (a) black outlined squares slide down the surface accumulating at the bottom; (b) the squares may be painted in different colors by placing hands, arms or legs on the surface; (c) a colorful mosaic is created; (d) on sliding down a splash of squares reconfigures the mosaic.

4.1 Children Behavior

Young children like to play with colors and shapes. One can give them a box of crayons and a piece of paper and they will start playing and drawing and, in spite of not trying to teach them anything in particular, they will be going through a creative process (that is also a learning process).

We did not want to substitute the already very rich activity of drawing on a piece of paper with crayons by a virtual version on the slide. We wanted them to experiment with discovery of changes through color and dynamics: both, dynamics of the virtual objects and their own bodily dynamics.

Therefore, we defined a strategy by which the system would assign each child a specific shade of color when they placed their arms (or any other part of their body, such as a leg or the head) on the surface of the slide. From this moment on the child would tint, with her color, any squares she (virtually) “touched”. The child has then the freedom of moving laterally along the whole width of the top edge of the slide to tint the squares as they appear. This creates different patterns of color at the bottom of the slide giving the child a rich environment for color composition on the mosaic.

If a child wishes to change the shade of color that has been assigned to her, she can take her arms off the surface for an instant and then place them back on it. This way the child can choose from a palette of shades of colors. If children collaborate with others, they can try to generate lumps of colors, patterns or even simple shapes within the mosaic at the bottom of the slide.

Once the children want to reconfigure the mosaic, in a sort of “reset” function, they can slide down the surface. On reaching the mosaic, their bodies “collide” with the squares in the mosaic and create a huge “splash” of squares that rearranges part of the mosaic. They can then run back up the stairs to start the whole process again.

4.2 Presentation and Use of the Virtual Mosaic

We presented this first application at a public event promoted by the European Commission (EC) called “The Researchers' Night 2007” (September 2007) that 150 cities around Europe organize simultaneously. It is an event addressed to the general public to bring research closer to society. Our university hosted part of the activities in the contribution from Barcelona (Spain) to the event. It was full of families and children that came to see different activities, talks and demos. The event lasted only for four hours in the evening.

We set up the slide there to show an unusual application of interactive systems and be able to explain how full-body interaction design can have an impact on society. We also wanted to observe how children accepted and used this platform and the application with respect to our expectations. We also wanted to test the technological and physical aspects and the design criteria we used for the shape of the slide.

The observations we made were informal. However, we had around 60 children from ages 3 to 10 that allowed us to test many aspects and see the adequacy of the whole set up.

The robustness of the slide was very successful. These structures remain very stable throughout the session. We also found the shape very adequate. For example, the area at the top of the slide proved to be a very safe design and did give full control to the users to be able to interact with the top of the slide. At the same time, it allowed them to slide down only when they decided to do so.

We allowed children on the slide only in groups of maximum eight and we changed groups every five minutes. Children found the application interesting and surprising during the first minutes. However, the older children found it a little tedious after a while and, unfortunately, started to use the slide without caring too much about the game. Although very young children did like the application and apparently would have used it successfully, because we could not really control the grouping of ages of children as they went in, we usually had a large mix of ages on the slide at the same time. This made it a little chaotic for the younger children.

We also observed that the speed at which we had defined the squares to go down the slide was much too slow. Children can run up the stairs and slide down the surface at a much higher speed than we had envisioned. This caused that the mosaic at the bottom was seldom consistent and dense enough to adopt any pattern that users could appreciate.

In spite of this, we got very consistent answers to the questions we informally asked the children. For example, we asked them to tell us what they thought the system allowed them to do. They did find out that they could tint the squares and that they could reconfigure the mosaic when sliding down the surface.

We are looking for an adequate place to set up this application again to test it more formally with children of the age we conceived it for and obtain more solid results. We will also increase considerably the drop speed of the squares to make it more feasible to obtain a dense mosaic at the bottom.

5. ROBOT FACTORY: THE SECOND APPLICATION FOR THE INTERACTIVE SLIDE

Now that we had tested the structure of the slide and we had obtained good results form the technology, we wanted to try to find an application that would really engage children while at the same time promote physical activity in a more determined manner. We decided to focus on older children to be able to take greater advantage of their physical potential, as well as because they are the population that are being more affected by this lack of physical activity that leads to health issues. Therefore, we defined the range of ages between 10 and 14 as the central target population.

To try to control the amount of physical activity of the application we defined the notion of “interaction tempo”. We took the concept of “tempo” from the realm of music as a metaphor to define a notion related to the pace at which the experience evolves. Because tempo is defined as “beats per minute”, it helps us in having a metronome-like measure of the pace of the experience.

With this in mind, we started to define an application that could clearly mark a tempo and try to imbue it to the children using it. Everything in the application should run according to a ticking clock: a metronome that would mark the tempo of the gaming elements in the application.

We again followed an interaction-driven design strategy [16] since the kind of interaction we wanted to obtain was a clear priority over any theme or content. In fact, we started to define the behavior of the application and the users without yet having a specific topic for it.

With the musical referent of the metronome as a basis, the design process led us to consider actions of the users that could follow clearly mechanical patterns; i.e. it related to a mechanical device so that the tempo could be important in the activation of different mechanisms. One of the references that immediately came up was Charles Chaplin’s Modern Times movie and his repetitive actions. Robots were another important referent for mechanical actions.

An important point for us was to obtain an application that promoted collaboration among the users. We did not want to allow individualities to succeed in the game and leave the rest of users aside. We wished to see organization of user tasks to emerge as a team that works for the same goal. Therefore, we decided that the system would trigger several actions simultaneously to force different users to act in parallel and they should all work together to, for example, construct something.

Finally, since we wanted the users to do some physical activity we decided that the experience would use as much as possible the whole surface of the slide. This way we would force users to go from top to bottom and from one end to the other.

The resulting application was Robot Factory. A game inspired by a production line, with a simple goal: to construct a robot. We defined a series of elements that would need to be triggered either to be able to construct the robot or to avoid it being destroyed. We chose a visual approach of a factory-like environment with gears, levers, valves, moulds, bolts, etc. Figure 5 shows a screenshot of the game.

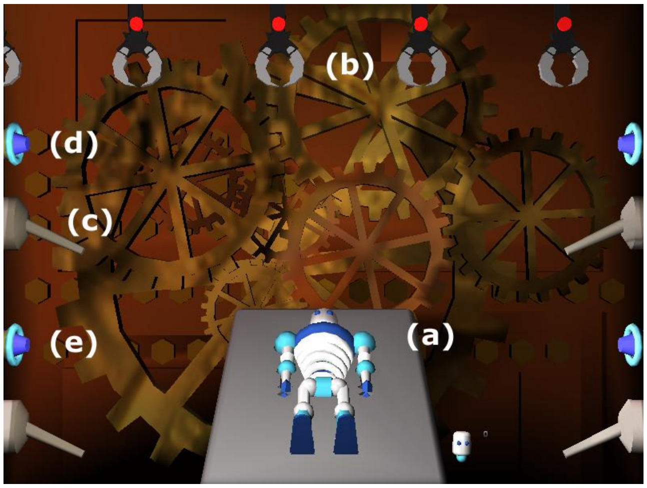

Figure 5: Screenshot of the Robot Factory application: (a) the mould with a constructed robot; (b) the chain of claws; (c) the levers; (d) the upper steam valves; (e) the lower steam valves (see text for more details).

The idea of the game is to construct a (virtual) robot on a mould that the game provides at the bottom of the playing area (Figure 5a). Users must construct the robot from its elementary parts, but to achieve this they must fulfill a chain of steps that are dependent on each other.

The mould "tells" the users which parts are needed at every instant. The users must get the parts of the robot from the chain of claws that continuously move from left to right at the top of the play area (Figure 5b). If one of the claws transports the correct part that the mould is asking for, one of the users must activate the claw, by moving over it, and make the part fall on the mould. However, the claws will not transport parts of the robot unless a user activates one of the four levers on either side of the screen (Figure 5c). These grey levers turn yellow and rise for a few seconds every so often. During this brief time, the users can slide down over the levers to lower them and hence activate them. If a user manages to do so, then a new part will appear in the next claw that enters the screen through the top-left. Users must pay attention to the fact that some of the parts that appear do not belong to the robot. Additionally, even if the part does belong to the robot, users must still beware the fact that they must only drop the part that the mould is asking for at that time. If a user drops a wrong part on the mould, the mould loses all the parts it had acquired until that moment.

To make things a bit more interesting there are four steam valves in the game. Two upper valves, one on either side (Figure 5d) and two lower valves, also one on either side (Figure 5e). These steam valves accumulate pressure every so often. When they do, they turn red and start shaking vigorously. At this point, a user must slide down over the steam valve to stop it from releasing a puff of steam. If a user does not manage to do so during a brief period of time, the valve then releases the steam causing calamities for the users. Specifically, the steam released by the upper valves (Figure 5d) forces the claws that are transporting robot parts to drop them at once in an uncontrolled manner. This might make a wrong part fall on the mould making this latter lose all the parts it had acquired until then. On the other hand, the steam released by the lower valves (Figure 5e) directly blows on the mould. This immediately makes the pieces in the mould disappear.

This chain of events entails ability, speed and strategy of the team of users. They must be well organized to attend the different events that the system is periodically generating. They must be fit to slide down and run back up to attend new situations. They must be quick in reflexes to notice the changes in levers or valves to be able to activate or deactivate them within the allotted time.

All events have an audio component to help the users identify them quickly. For example, the valves set off an alarm when they are about to blow out their steam. The sound is stereo spatialized by loudspeakers placed on the lower part at both sides of the play zone to help the users identify where the event is taking place.

Our intention was that these game mechanics were to be straightforward enough for the users to understand them rapidly, and at the same time be complex enough to appeal our young users. Nevertheless, before the play session started, we provided the users with written instructions in the form of a schematic diagram [22].

Finally, acting as the motor of all these mechanics, a virtual metronome is in charge of marking the pace of the game. According to the main clock, at each tick a lever has a certain chance to go up or a valve to start to activate. They also stay active a certain number of ticks. The claws on top of the projection, too, move sideways at different speeds according to this metronome.

We defined three different tempi to try them out with different groups of users and see how these adapted to each different pace: a slow tempo at 43 BPM (approximately a tick every 1400 milliseconds); a medium tempo at 60 BPM (a tick every 1000 milliseconds); and a fast tempo at 100 BPM (a tick every 600 milliseconds). When the tempo is fast, the claws move quite fast, steam valves start activating rather often and release the steam in a short time, and the levers will go up often but stay up for only a short time. The overall sensation is that of a very fast (and demanding) game. On the contrary, with a slow tempo, all the elements of the game have less chance to be triggered but stay active for longer, so the overall feeling is that of a more calmed game.

5.1 Presentation and Use of the Robot Factory

We presented this experience at another event promoted by the EC called the Euroscience Open Forum 2008 (ESOF08). It took place in Barcelona (Spain) from July 18 to 22. We presented the slide within the Outreach section that was open to the general public (Figure 6).

Since we had already tested the structure of the slide in the previous event, at this event our goals were more oriented to test the experience. We wanted to test whether we could achieve that users play with the game and the slide as a single unit. In other words, we did not wish to have users that completely forgot about the game and played only with the slide as if it were a standard inflatable.

Figure 6: A view of the Robot Factory application as presented at the EC event ESOF08. A family playing together: (left to right) son age 8, daughter 14, father 37 and daughter 17.

We also wanted to have a first vision of how users adapted their play intensity, their physical activity, to the interaction tempo of the application. This is important because if we want to use this platform to enhance physical activity of children, we must eventually prove the following:

- That we have a way to measure physical activity of groups of users (at this point we do not intend to work with tracking individual users).
- That our system can influence the amount of physical activity done by a group of users (in our case, through the notion of interaction tempo).
- That our system can modulate and automatically adapt to the amount of physical activity done by a group of users.

We are already designing quantitative experiments to prove each of these points in the future. Our intention is to have the first two points proven during this year 2009 and then be able to attempt the final point by the end of 2010.

In the meantime, we obtained very important information from the ESOF08 event thanks to the observation of large amounts of users, to preliminary experiments we set up for it, and to an ongoing ethnographic study that we started at the beginning of the project with an external observer through the strategy we call the “embedded ethnographer”. We expect this study to provide important information in the next few months when it is completed and analyzed.

5.2 Observations and Preliminary Results

During the four days that the ESOF08 lasted for and a total running time of 38 hours, +1030 users played with the Robot Factory application in groups of three or four users and in four-minute sessions per group. This resulted in 292 groups that played with the application.

The age range of the users was from 3 to 59 years old, which showed that people from all ages were attracted to play with the experience. However, 80.4% of the users were between 5 and 15, showing that we were indeed focusing on our target group. Even more, 34% were exactly within the 10 to 14 years old target range that we had defined for the application.

We asked all the users to read the instructions of the game [22] and they had the chance to ask us questions about the rules before starting the experience. Many of them saw other groups playing before the experience, and many repeated either with the same group or with a different one.

After filtering out the groups where abnormalities occurred (such as someone entering or leaving the game half way through a session), a total of 274 groups, representing 971 users, were used for a preliminary analysis and observation.

5.2.1 Attention

A very important first observation was that the users kept the attention on the game throughout the experience and were not at all inclined to play with the slide outside the rules and actions of the game. This was a very important achievement for us to, on the one hand, confirm that the interaction design was adequate for this medium, and on the other hand, to verify that the rest of the observations were actually being done in the correct context of user experience.

The initial analysis of the ethnographic results apparently confirms these informal observations. The ethnographer realized interviews to the groups of users immediately after their experience and obtained very spontaneous answers. Following the usual ethnographic method, the ethnographer asked the questions as much as possible without biasing the answers. For example, by vaguely pointing at the whole installation and asking “Can you tell me what this is?”

Surprisingly enough, in spite of the formidable physical presence of the huge inflatable slide, the users seemed to ignore it in their answers when the ethnographer asked them to describe the experience they just had. Specifically, the majority of users referred to the experience as a “program”, a “game”, a “videogame” or a “computer game” and only in very few cases did they mention the physical slide. This was outstanding because all of them had been constantly physically jumping, climbing and sliding on the inflatable structure.

5.2.2 Interaction Tempo

During the four days, we applied sequentially one of the three different tempi to each group of users. After the observation of these many users on the slide, it is remarkable that a lot of them did not seem to notice the different tempi of the game, especially when playing. It was actually easier to notice by external observers. Additionally, none of the users complained about the game being too fast or too slow at any time, which also informs us that the game was playable (and enjoyable) in all of the tempi. In fact, we had envisioned that the fast tempo (100 BPM) would actually be too difficult for most of the groups. However, all the groups that got this tempo were very motivated to manage the control of all the active elements in the game.

5.2.3 User Behavior & Play Strategy

The observations were also useful to make us notice that many users were adopting a very different play strategy than we had actually envisioned. As described earlier, we had foreseen that the users would be running up the stairs to check from the top of the slide which elements of the game required an action from them. Then users would slide down to activate or deactivate the elements and run back up again. However, although we had indeed thought of the possibility that some users would use the ramp to go back up, as opposed to using the stairs, we found out that many groups organized themselves in two blocks. One block composed of one or two users at the top to drop robot parts into the mould and a block composed of two users standing at the bottom and jumping up and laterally to activate levers and deactivate valves.

We discovered this was due to a slip in the detection of activity in the artificial vision system that did not impose the restriction on the users of having to slide down over the active elements. Rather, the system allowed the users to act upon the elements by just generating any movement whatsoever over that element. Therefore, in fact, these groups of users found a more effective way of interacting with the experience. Unfortunately, this fact apparently forces them to do less physical activity than we hoped for and would invalidate the way we had envisioned to calculate the amount of physical activity.

Nevertheless, this experience will now allow us to undertake successfully a formal quantitative experiment to measure the amount of physical activity of the groups of users and how it is related to the interaction tempo of the game.

6. CONCLUSIONS

We have presented a novel interactive playground structure, the Interactive Slide, based on a traditional playground element that we have augmented with interactive technology. We have also presented two applications, “Virtual Mosaic” and “Robot Factory”, which we have especially conceived for this platform. We have described the design criteria of both, the physical design of the slide and the interaction design of the applications. We have also discussed on the successes and failures of each application.

This physical and interaction design has successfully addressed the following points:

- Multi-user experience: to provide a socializing context and a rich experience. We managed to see organization of user tasks emerge as a team that worked for the same goal in the Robot Factory application.
- Naturalness: in both, the physical aspects of a well-known play structure and in the correct adequacy of the applications to the physical activity we obtained very good results.
- Meaningful: both applications provide rich experiences to the users.
- Robustness: the inflatable slide used is a robust structure that at the same time is safe and easily transported.
- Non-Invasive: the users need not use or wear any sensors on their bodies and can immediately start playing on the platform.
- Safety: the structure is both safe in what concerns the physical design of the inflatable structure and in what concerns the augmentation with the interactive technology.
- Physical Activity: the platform provides very promising potential to encourage children and youngsters to engage in physical activity while playing on the platform, without actually being too much aware of the fact that they are making this physical activity. We have achieved this through the notion of “interaction tempo”. However, we still have to undertake formal experiments to understand and prove our hypotheses.

As future work, we must redesign some aspects of the applications. For example, the speed of the mosaic squares in the first one and the artificial vision detection of activation of elements in the second. We also have three important points to prove in the following months to be able to offer this platform as a useful tool to enhance physical activity and socialization in children and youngsters.

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