

The Drawbox Project - Open Ended Play Over a Distance

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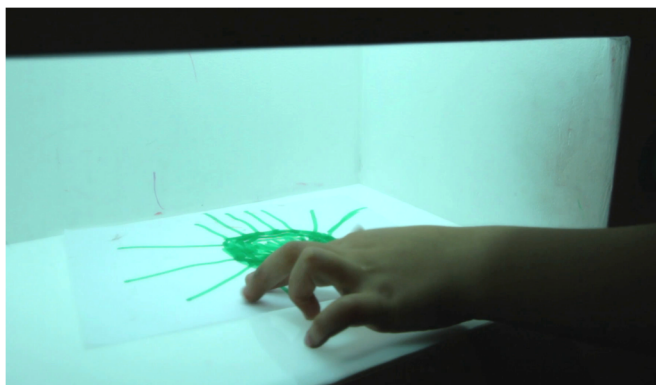


Figure 1: placing a drawing in the Drawbox

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Abstract

Open ended play allows children to interact in a free and expressive manner, without defined goals. It is typical of co-located play. We describe a dual-location installation created with the goal of enabling real time, open ended interaction between children in the two locations. We present the play and design values that led to the development of the installation - the Drawbox project - as well as the implementation, and observations from children interacting in two museums in two countries.

Author Keywords

Open ended play, Drawing, Remote interaction, Physical simulation, Connected playgrounds

ACM Classification Keywords

H.5.2 User Interfaces: User Centered Design.

1. Introduction

The Drawbox Project was born out of a commission received from a national design museum. The context was a large exhibition titled "Playing at the Design Museum" [1], which included two parts: an exhibition of contemporary children's illustration, and an exhibition of playground design. The museum requested an interactive experience that would connect children in two different locations: a divided playground in which

children could playfully engage with each other, across a physical and cultural distance.

The abundance of connective technologies and high bandwidth communication channels made the design space extremely wide. From real time video streams to multi player online games, the possibilities of connecting remotely are vast. This required us to carefully define the specific aspect of play that was right for the special environment of the connected museums. This environment created challenges and opportunities: at times, there would be many visitors; at other times, few. Sometimes one museum would be closed, and the other would need to function in an interesting way by itself. The profile of the visitors was also wide - children of multiple ages, accompanied by their caregivers.

1.1 Open Ended Play

Play can be goal-driven or open ended. In contrast with games, which have goals, structure, and a competitive aspect, open ended play is chaotic, infinite, improvisational and expressive [2]. Open ended play is typical of the simplest toys - a stick can either be a sword, a pen to draw on sand or a walking cane - but open-ended play has also been the object of design in interactive systems, both physical [e.g. 3,4] and screen based [5].

It became obvious to us that we did not want to create a goal-driven play interaction, but rather a form of open-ended play that could be engaging to many ages, in all configurations. Seeking an activity that would be easily achieved, inclusive, enjoyable, and in synergy with the context of the exhibition, we chose drawing.

1.2 Drawing

Drawing is a simple, yet rich, form of self-expression. We start drawing as early as we can hold a crayon, we sketch and doodle through life. Drawing is both a personal endeavor, used within an internal dialog, and an inter-personal endeavor, used to convey ideas to others [6]. Drawing also forms the basis for many forms of play, from personal activities such as coloring and connect-the-dots, to social games such as Pictionary and the Dada-inspired Exquisite Corpse drawing game in which a group of people cooperatively draw a person. Playing a guessing game through drawing - over a distance - recently became a hit with the 'Draw Something' mobile app game [7].

Downloaded 20 million times in the first five weeks after its launching, the game was subsequently bought by the gaming company Zynga for \$180 million [8], a testimony to the communicative and expressive power of a drawing, even when disembodied from the person who drew it.

In the Drawbox project, a pen-on-paper drawing is the starting point for a playful transition between the physical and digital worlds, and for a new type of real-time connection between children in different locations.

2. The Drawbox experience

Players in each museum enter a space with many tables with coloured pens and white paper. They draw, and then place their drawing in a box with an opening and press a large arcade button. The drawn shapes instantly fall into a projected, graphical world inhabited by shapes drawn by other visitors. As the shapes enter the world they bump and jump, collide and break up, retaining enough of their form to be identifiable, but changing enough to surprise and delight.

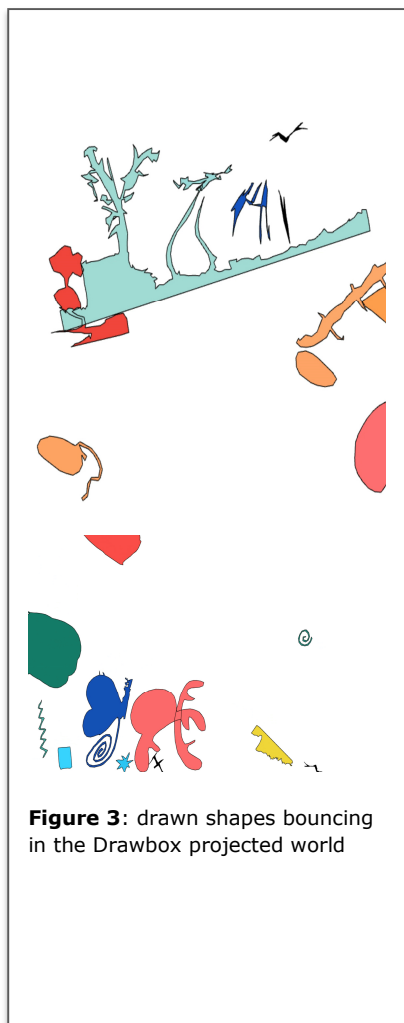


Figure 3: drawn shapes bouncing in the Drawbox projected world

The projected world is in constant motion: shapes that exit to one side of the world enter at surprising times and orientations on the other side. Sounds of collisions between shapes extend the materiality of the drawn world, creating a magical landscape-soundscape.

Visitors in the two remote locations all contribute to a single, shared world. Shapes delivered from each location are shown in a selected colour, in order to identify their origin within the shared world. Participants witness each others' creations; they can relate to the drawings of others with their own, and correspond with each other through drawing, creating a form of playful dialog. When only one location is open, the shapes retain their original colours (see section 3.2 for details).

2.1 Design values

In a world of wide-band communication and digital "everything", we sought to create an interaction based on the beauty and simplicity of the physical drawing, and an opportunity for a calm, gentle channel of communication with others. The themes explored in the Drawbox Project: open ended play, self-expression and the connection with the other, were selected to appeal to children in a wide range of ages and regardless of cultural identity.

The physically simulated bouncy motion and sound, as well as the gradual disassembly of the shapes, were chosen to give the play experience a layer of surprise, comic quality and serendipity, as well as to make the drawing process less "precious".

The Drawbox project creates a platform for spontaneous play interaction with other children through the act of drawing – both co-present children, and those in the remote museum. Simplicity is a main design value in the project: a single button constitutes

the entire interface, making it inclusive to children of young ages and varied abilities.

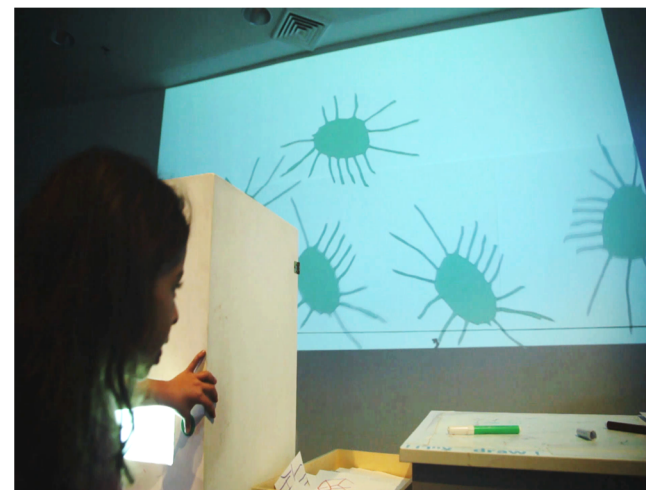


Figure 2: pressing the button adds the drawn shapes to the animated world

3. Implementation

The Drawbox is built from off-the-shelf materials and custom software built with Processing [8]. The implementation is hereby described in detail.

3.1 Physical box

The Drawbox box is a rectangular standing structure built of wood. At its centre is a cavity in which the drawing is placed. The cavity is well lit from above using fluorescent lamps. A high-resolution camera is installed at the top of the opening, concealed from children's reach. A 35mm concave momentary push button is connected to a Mac Mini computer via a hardware interface (iPac controller [10]); pressing the

button causes camera to capture the image and initiates the image processing.

3.2 Image processing

Contour, dominant colour, and morphological analysis are performed. Each contour is converted to a vectorised polygon and added to a physics engine simulating rigid body dynamics in 2D. The new virtual shape is initiated with physical parameters corresponding to the morphological features of the drawn shape. Shapes are analysed to retrieve their relative size, total area, density, calculated as the ratio of drawn area relative to the bounding box area [11], and shape symmetry, as judged by the centre-of-mass position relative to centre point of the shape's bounding box [12]. The newly created virtual shape is re-coloured according to the location (or tinted by the dominant colour of the drawn shape, if only one museum is open).

3.3 Physical simulation

The shape features are mapped to physical world parameters – body mass, body friction and restitution (the strength with which the body bounces back from a collision). When entering the world, the shape gradually breaks apart, separating into the loose contours comprising the original drawing.

3.4 Sound design

We designed sounds that enhanced the materiality of the drawn objects, giving them a quality of realness while also adding a playful, comic aspect, in line with the quality of the colourful drawn shapes and their bouncy motions. The detection of object collisions is utilized for constructing a sound generation engine which sonifies the world dynamics through velocity-to-amplitude mapping. This reflects the language of

physical motion dynamics, such as acceleration, mass, collision, elasticity, etc. Equipped with a library of custom-made sound samples, the sound engine scales the force of objects collisions to a relative amplitude of sample playback.

3.5 Data

Drawings from all locations are joined through a shared cloud-based data folder, which allows easy installation and enforces no limit on the number of Drawboxes which can be connected in a network, in the future.

4. Installation

The project was installed for a weekend at the Design Museum Holon and the Victoria and Albert Museum, London. We observed a great interest and high level of participation by visitors of all ages in the Drawbox.



Figure 4: visitors drawing and sending in the installation

It seems that the ease of participating (making a simple line drawing), coupled with the temptation of seeing what happens to the drawn shapes when they fall into the world, were good incentives. While some participants created refined drawings, most created quick, playful sketches.

4.1 Local play

Children enjoyed drawing on their own on one of the installation tables, and then having their creations gain the centre stage as they place their drawing in the Drawbox. They often pressed the button many times to fill the drawn world with multiples of their creations. Beyond the deep engagement of children with the installation, we observed motives of iterative exploration: as children witnessed the effect the Drawbox has on their drawing, and on other's drawings, they were often compelled to refine their drawing, seeking to enhance the effects, or to "outwit" the system by drawing their shapes such that they will break and scatter in a certain way.

4.2 Remote interactions

Once told that shapes with the different colour are arriving from another place in the world, some of the children - especially those over 7 years old - expressed deep curiosity towards the faraway children, and actively sought ways to communicate.

Two recurring examples were:

- **Messaging:** trying to communicate symbolically, by writing a greeting (e.g. "Hello"), or sending a drawn message (e.g. a waving hand). In one case children tried to teach their letters to the other side.

- **Contagion:** responding to a drawing with another drawing (e.g. drawing a spider in response to a spider that arrived from the other location).

Interestingly, at one time we observed what might have been a hostile drawing (a missile) sent from one side to the other.



Figure 5: sending a message

5. Discussion

In the short time in which we observed this interaction between children over distance, we saw promise and potential for a spontaneous playful dialog.

A main question for future design iterations will be the balance between the interaction occurring locally - between co-present children, their drawings and the Drawbox - to the interaction with the remote children. Achieving the optimal level of awareness to the remote

others – enough to enhance curiosity and communication, not too much to take away the pleasure of the simple, local drawing experience – is a great design challenge.

In the current design, locations were identified by colour, and the remote presence of children in the other location was verbally explained to the participants (e.g. “the yellow shapes are being drawn in London!”), as well as explained in the installation texts. We felt this was too little: in a next iteration, we will strive for a more structured and prominent awareness of the remote children, while maintaining the drawing as the main communication channel. One option we believe holds promise is to show - in each location - a real-time video stream of drawing hands - but not faces - of children in the other location. This search for the optimal play experience: loose, expressive, serendipitous, will be the main focus of our future work.

In our view, remote “connected playgrounds” – shared playful experiences which transcend physical distance – are a unique tool to promote and foster a playful channel of interaction between people from different cultures, driven by spontaneous exchange and discovery of a common language. It is our hope that this line of research will show the potential of these playgrounds to creating bridges of curiosity and trust between people of cultures divided by animosity and prejudice.

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