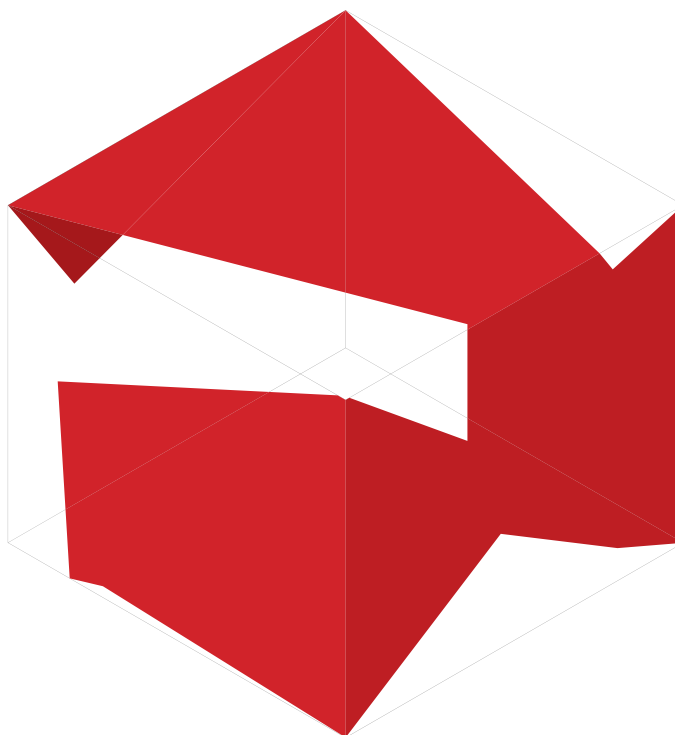


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I Mirabilia, taking care of the emotional life of hospitalised children

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Abstract: I Mirabilia ("The Wonders" – see Figure 1) are a family of three interactive dolls for children who spend a long period of time in hospital, due to terminal illnesses or periodic therapies. Drawing on interviews and observations in a children's hospital, three dolls were designed to help overcome specific emotional difficulties faced by children in this situation. The different interactions and behaviors triggered by the dolls enable the children to improve their relationships and make new connections with the people within the hospital, such as doctors, psychologists and other hospitalised children.

Keywords: Children in hospital, dolls, emotional needs, psychotherapy, non-verbal communication, haptics, tangible interfaces

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Introduction

The hypothesis is that a set of dolls would, in a way more physical and direct than screen applications, provide for different emotional needs which children with terminal or chronic illnesses often have but do not easily show. Using non-invasive interactions and intimate contexts of use, I Mirabilia offer a playful emotional support for hospitalised children, easing the work of doctors, psychologists, nurses and all who take care of the psychological side of these children. Odo, Tello and Lucio cater for these tricky psychological states and offer emotional benefits through an act of play. Their aesthetic mood and interactive behaviors are designed specifically with the needs of hospitalised children in mind, and would fulfill the original aspiration of the project best in this context.

Existing project and background research

The research began with a study of existing projects designed for hospitalised children with different aims such as: increasing awareness of their symptoms, teaching them something about the hospital environment, creating a collaborative game for interacting together or simply allowing them to play and have fun in a relaxed and social environment.

The main medium used in existing projects to reach these goals are screen-based applications offering fun interactions, colourful interfaces and intelligent metaphor. However, as these solutions focus heavily on the digital interaction they do not cater for social relationships and human empathy, important qualities for children in hospital. The focus of the project therefore moved to physical objects, which filled this gap by improving the children's connection to the world outside the hospital, with external stakeholders such as family, classmates and teachers. This enabled me to move closer to the initial goal of the project, which was to improve the human-to-human and human-to-machine interaction. The majority of existing projects using physical objects, however, aim to improve the relationship between hospitalised children and their family and friends outside, which triggered the question: what are the challenges faced by these children within their everyday environment?

With the concept goal clarified, focused research sought inspiration and ideas from the specific characteristics of existing projects. Sniff [6] and Echo [12], in particular, helped define the interactions of I Mirabilia. Sniff is a smart toy dog that uses non-invasive and non-verbal interactions to help visually-impaired children learn the meanings of different emotional states through haptics and sounds, improving their social skills and knowledge. When the tags of different emotional states are scanned by the built-in RFID reader in its nose, the dog translates it using sound and haptics, thereby driving the children to discover the meaning of emotions in a fun and colourful way. Echo is a rabbit that allows children to share their secrets by whispering into its ear. Having a special place or a person to keep secrets safe is common in childhood and if this could be your favorite toy and a friend at the same time, even better. Other consistent and smart projects have been StoryTail [7], a blackboard and Pling Plong [13], a pillow, that inspired the storytelling aspect of I Mirabilia. Both these projects use storytelling to encourage children to build their own story and to develop their creativity. Storytelling is a method used more and more by psychologists in hospital to let children project their frustrations indirectly. CubeBuddy [3] and Interactive Dolls [11] both focus on the relationships children establish during play. CubeBuddy is a soft cube used by hospitalised children to communicate with each other at a distance, simply through colorful light codes.

Children in different rooms can play together by tapping their CubeBuddy to send light signals to each other. Finally, Interactive Dolls are a couple of fun dolls used in pairs to teach children the most common social behaviours through sounds and verbal feedbacks shown on a monitor.



Design process

Interaction design literature describes various ways in which interactive toys have been used for psychotherapy, and reading about the child psychology led to a focus on toys to support children in hospital. As yet, Interaction design's contribution to ameliorating the psychological distress of children with terminal illnesses has not been deeply explored. Most existing projects are screen-based applications created to provide fun and relaxing moments, rather than focusing on the causes and consequences of the tricky mental states of children in hospital.

The approach taken was to design a group of dolls to address the most common psychological issues and then to take these initial ideas to interviews with medical personnel. This allowed a first exploration of the design possibilities which gave the interviewees an idea of the type of thing that could be possible so the next interviews would be more focused and effective. We were prepared to abandon this approach if necessary but it turned out that these initial ideas were deemed very appropriate by the people interviewed; their insights and later observations in the hospital allowed a deepening of the focus of the project on the psychological side of children and how to allow them to give voice to their frustrations.

Prototypes of two of the dolls were made, and a simulation of the third. Because of the strong child-protection regulations in Italy it was not possible to test the prototypes in hospital; however feedback from a group of children of a similar age outside hospital was obtained, leading to further refinement of the designs.



Figure 1. I Mirabilia.



**Observations
and interviews**

I Mirabilia, with their humorous and quirky natures, aim at children from 6-12 years old, who are required to spend a long period of time in hospital due to terminal illnesses, cyclical therapies or recurring hospitalisation. Other stakeholders include the family, nurses, psychologists, doctors and all who take care of the psychological aspects of the children whilst in hospital.

Detailed user observation and interviews at the Meyer hospital for Children in Florence (with the Games Room Coordinator, the Clinical Risk Manager, and a nurse on the children's cancer ward), resulted in a deep understanding of the users' needs and the context in which the three dolls could be used. One of the key findings was that prolonged hospitalisation at such a young age provokes a variety of emotional problems, often requiring them to undergo psychotherapy. Common symptoms are anger, depression, weakness, regression to childish behaviour, silence, tiredness, guilt, loneliness and shyness. The last three are the most relevant psychological issues. The feeling of guilt comes from the child's unawareness of why they are in hospital, which is often hidden from them by their parents wrongly trying to protect them. The second condition, loneliness, is a direct consequence of the first period of hospitalisation, when children feel uneasy making new friends because they are ashamed of their condition. The third issue, shyness, is a very common psychological state of young patients that is often manifested by building a thick barrier which limits their expression and social interaction.

From the interviews with hospital personnel, it emerged that children, regardless of age or type of illness, face almost the same psychological problems according to the period of their hospitalisation.

The youngest children in the ward (2 to 6 years old) show less shyness than older children, but in the first period they lack confidence with the doctors, frequently looking for the support of their parents. Teenagers (11 to 18 years old) tend to be more shy and silent because they feel ashamed, especially about the physical and aesthetic changes caused by the disease (shedding hair, weakness, etc.). However, while they often express anger against their parents they also easily share their distress with the staff. For instance, a nurse said that a 13 year old girl who was really upset with her mother, shouted in her face in the ward corridor, blaming her mother for her needing to be in hospital.

This fact illustrates how shame, for example, is faced differently by children who share the same experiences and emotional states. The interviews provided many important indicators allowing the mapping of the most common psychological problems to reach the final three addressed by the dolls: guilt, loneliness and shyness.

The relationship levels

The three psychological states required precise contexts of usage in order to create a specific level of relationship between children and other users. Following Jean Piaget, an age range was identified to elaborate three relationship levels to let the children use their dolls appropriately to their stage of development.

The first relationship level is 'introspective', which involves Odo (see Figure 2) and a child dealing with the subconscious fear of being hospitalised. Odo would help him/her to face the fear and to think about the situation in a deep and careful way. Lucio (see Figure 3) aims to create an intimate one-to-one relationship between two friends to strengthen their tie. Lucio generates a gentle connection just between the two users to reinforce the concept of mutual sympathy and comprehension typical of two people with the same needs.

**Interaction, design
and context of use**

Odo is a secret-keeper who helps the child, in particular one just hospitalised, to fight the guilt, anguish and fears typical of a child in hospital. Difficulty in expressing these negative psychological states to unfamiliar people like doctors and nurses is solved by Odo, who becomes a special intermediary between the child's unconsciousness and the psychologist. Odo is specifically designed to fight guilt. Particularly in the first period of hospitalisation, children don't understand why they are there and they think, in most cases, the hospitalisation is a type of punishment from their parents for something they have done. If this anguish is maintained, it can increase day by day, becoming dangerous for the child's mental health.



The context of use in which the doll could give a real and tangible benefit is in the personal bedroom of the child at the hospital. During a time in which the child is alone and has the possibility to think about his/her situation, Odo becomes an intimate friend who listens to the child's frustrations and gives him/her the possibility to feel more calm and thoughtful. It is obvious that if the secret were to be revealed to the psychologist, the benefit for both of them would be significant. The children would be more aware of their problems and the doctors could use alternative tools to help them.



Figure 2. Odo - the interaction.

The interactive areas of Odo are created with a red dotted fabric, which stands out and makes the interaction more intuitive even if non-verbal. The overall affect of the doll uses illustration, colour, and friendly dog features.

By using a hand to lift Odo's ear, the child can whisper a frustration into its ear. When both the hand and the ear are released, the secret is recorded and Odo's cheeks immediately blush and his eyes start to blink gently. The hand/ear gesture allows the child to play with Odo without the risk of recording something accidentally. If the child decides to let Odo tell

the secret, he/she softly knocks on its back three times and Odo reveals the secret. Its cheeks gently turn off and reset the system. The interactions use two LEDs behind Odo's cheeks, one micro-switch inside every ear and hand, a microphone to record the speech, and a capacitive touch sensor on Odo's back which detects the three knocks.

Odo is powered by a communication between an Arduino board and Processing, thanks to the Minim and Serial Libraries. The hardest part of coding the prototype was managing the recording because of its various states: recording if the buttons are pressed, stop and save the recording when buttons are released and the cheeks start to blush, playing the recording only when the sensor is touched three times consecutively. The Arduino was programmed to send a specific signal for each of those actions to Processing, which managed the recording and playback appropriately.

Because of the delicate situation for which the doll is designed, it cannot be sold in an ordinary shop. The doctors deliver it when the child comes into the hospital, explaining to the child how and when it could be useful.



Figure 3. Lucio - the interaction.

Lucio is a curious night-time friend who creates a gentle connection between two children located



in different rooms, allowing them to fight their feelings of solitude. Lucio is active only between 8pm and 7am because it is specifically intended to establish an intimate relationship during the night, when children usually feel scared of the dark and lonely.

Between two children Lucio establishes the mutual sympathy and helpfulness typical of the deep friendships started in hospital. Using haptics as the main medium, with a delicate exchange of lights and vibrations, Lucio becomes the ideal intermediary among children's needs. Lucio is suitable for all periods of hospitalisation. If a child feels scared, or simply needs the presence of someone else, he/she can send a call for help and receive feedback from his/her friend.

As with the other dolls, Lucio is made of colourful cotton, with a different texture in the interactive areas. He is reminiscent of a sleeping cat: sleeping, because he has to be used during the night and transmits his quietness; a cat, because one of the haptics used is a vibration which reproduces a cat's purr.

Squeezing Lucio's belly, a child sends a help call to another Lucio which detects it. The left hand of the Lucio-receiver flashes red until the child holds it. The flashing then calms down and the other Lucio glows blue and starts to purr. If during the night the child releases Lucio's hand, it slowly dims, as does the glow and purr of the other doll. The components of Lucio are: a blue LED on the belly, a red LED on the left hand, micro-switches inside the hands and the belly which detect the squeezing, and a vibrating motor inside the belly.

The colour code of the lights is easy to understand: the red light with its speed is a kind of alarm, while the blue light is intended to make the child feel calm and relaxed, thanks also to the purring sound.

Lucio is powered by an Arduino. The trickiest part of the code was the interrelation of the several states of vibration and lights, controlled by switch statements. Lucio would be delivered to the children by the nurses who take care of them during the night.



Figure 4. Tello - the interaction.



Tello (see Figure 4) is a fun storyteller who uses sounds to let children cooperate to make a story together. Tello allows children to play in a fun and relaxed environment, building different stories every time. In this way, children during their daily visit to the hospital waiting room can fight the shyness and boredom by meeting new friends. Tello makes it possible for children to project their own unconscious needs in a fairy tale, with this becoming an important therapeutic tool. Usually, most hospitalised children in the first period of their disease are shy and have difficulties in forming new relationships with other children. Tello would help them to fight this feeling using the storytelling method and sounds, allowing children to create a cooperative story and share these feelings better to understand their disease and to learn from the experiences of others.

With a colourful set of 16 lollipops, with a specific meaning in the context of a story (blue for weather, green for places, yellow for animals, red for actions) and a particular related sound, Tello is able to “eat/read” the lollipops and play the corresponding sound to let the children build their own story through an alternative collage of sounds and imagination.

A group of children, each with his or her own Tello, share between them 16 lollipops. The dolls detect each other and make a sound. After a few seconds, the tongue of one Tello glows in a random colour. The associated child puts one of the four lollipops of the corresponding colour on Tello’s tongue and it reproduces the related sound (indicated by an icon on the lollipop’s stick.) In doing so, the child starts to tell a story based on that sound. After a few seconds, Tello’s tongue starts to blink, then turns off, completing that child’s turn. Randomly, another tongue turns on in a random colour indicating the next turn. The next child repeats the action with another lollipop whose sound stimulates him or her to continue the story, and so on. The children finish the game by shaking their Tellos. When all the Tellos have been shaken, they turn themselves off and reset the system.

Tello’s components are an RFID reader, an RGB LED in the tongue, audio tags for the lollipops, and a tilt sensor to detect the shaking. For Tello a simulation with just two buttons demonstrated the working of the doll. If you press the first, the program starts, a blue light turns on inside the tongue, and after 10 seconds the sound of rain is played. If you press the second, the light blinks quickly, indicating that the time is up. All these are managed by communication between the Arduino board and Processing: the Arduino sends a signal when a button is in the right state and Processing then plays the related sound.

Tello is the most fun doll of the three and for this reason his aspect is smiling and funny. The metaphor of the “eat/play a sound” is allowed by the presence of a visible tongue and by the bright colors of the lollipops, which catch the attention of the children. This metaphor makes the game more interesting and involving. Tello is also the hardest to understand, so he would be delivered to children by the doctors or the games room coordinator who would explain the behaviour of the dolls and assist them, with their parents, during the game.

Children’s feedback

The quick user-testing session done with children outside the hospital environment, used to test the effectiveness of the project, was really satisfying and helpful, despite not being a real life situation. The session involved three children aged 6, 10 and 11 years old who responded with interesting feedback such as the suggestion of different contexts and ways of using the dolls. They immediately understood how to interact with the them and were instinctively drawn to the doll I thought appropriate for their age. Some quotes below were significant:

- “I would keep it in a safe hiding place, thus nobody can listen to my secrets.”
Gloria 11 years old, about Odo
- “I wouldn’t use Lucio with my mum, she would immediately fall asleep! Instead, with my best friend it makes sense!” Eleonora 10 years old, using Lucio
- “I like the fact it [Tello] makes only sounds, so the story is all by me.” Ermanno 6 years old using, Tello



Conclusion

I Mirabilia is a family of three interactive dolls which allow children to improve their relationships in hospital with other users through different behaviors and interactions. The most challenging part of the project was to understand the children's conditions in terms of symptoms and psychological effects, and designing specific interactions to help overcome them. On-site observation of the users and their reactions to the prototypes contributed greatly towards creating the final solution.

The interviews at the Meyer hospital helped define the context of usage of each doll, as well as to iterate the design of the dolls. The non-intrusive interactions, haptics and general appearance were especially well received by the non-hospitalised children interviewed. Their responses and intuitive comprehension of how to interact with the dolls without any instructions encouraged the development of the product with conviction.

There could be several possible further improvements in terms of technical adjustments, mood and concepts, in relation to the way the children's states of mind evolve over time. As well as the three psychological issues (guilt, loneliness and shyness) considered, one of the future developments could be to look at other critical mental states to provide for children's needs related either to other kinds of diseases or indeed to healthy conditions. During the first part of the research, the mental condition of abused children was another context in which a doll like Odo could be used, thanks to its interaction based on revealing secrets.

Regarding the technical side, several improvements could be made: better positioning of the LEDs, to produce the best light effect possible; and with the third doll, Tello, building the circuits and calibrating carefully the sound perception—as this is central to its success.

Finally, in terms of target choice, the concept fits the defined age range well but it would also be possible to explore a wider age range and children with different illnesses and symptoms, for which an extended family of I Mirabilia could serve.



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Gillian Crampton Smith began her interaction design career in 1981, designing and programming a magazine layout application. This prompted her passion for bringing graphic design knowledge to digital design. She taught interaction design at St Martin's, later becoming Professor and Head of Department at the Royal College of Art. In 2000, invited to Italy by Telecom Italia and Olivetti, she set up the research and teaching institution Interaction Design Institute Ivrea, and in 2006, with Philip Tabor, founded and now coordinates the Interaction Design programme in the Visual and Multimedia Communication masters course, luav University of Venice. Her collaborations have included Apple Computer, Interval Research, H-Farm and IDEO; she is now a Research Affiliate at MIT. Her career has concentrated on encouraging design students to think innovatively about the potential of digital technologies and persuading companies that design can transcend just problem-solving; she believes that business and academia, in collaboration, have much to learn from each other.

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Philip Tabor studied architecture at Cambridge, where his PhD concerned CAD (computer aided design), and was for many years a partner in Edward Cullinan Architects. He co-founded the Land Use and Built Form Studies research centre (now Cambridge University's Martin Centre) and Applied Research of Cambridge, a company specialising in developing CAD software (later sold to aircraft manufacturers McDonnell-Douglas). He was awarded a Personal Chair in Architectural Theory and Criticism at University College London, where he was the Director of the Bartlett School of Architecture. He taught at Interaction Design Institute Ivrea and, with Gillian Crampton Smith, founded and now coordinates the Interaction Design programme in the Visual and Multimedia Communication masters course of the Faculty of Design and Arts, luav University of Venice. He believes that interaction design can and should equal architecture's historic role: to develop and transmit social values and cultural meanings subtly, wittily and movingly.

