SLEEPLESS NIGHT

A Lighting Panel for Kids

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Abstract. Creating this product started with the challenge of developing a textile-based product that incorporated design, human interaction and light. Very early on during the design process, a gap in the kid's segment was identified leading to the investigation into children's illumination products and the idea to develop a new form of night-lights. Looking at existing technology and products, the idea became clear: to develop an interactive wall panel that reacted according to specific stimuli. By carrying out questionnaires and interacting with children in person the specific stimuli were identified; the panel would react to sound and movement. To build the panel electronic equipment such as LEDs, a microprocessor, sound sensors and movement sensors were used, along with MDF boards for the structure and specific fabrics for appearance. Due to a thorough investigation, specific colours and shapes were identified. Consequently, the outcome was a product we believe provides interaction, well-being and safety to the young target users, along with providing the parents with a calm and peaceful environment for their loved ones to sleep.

Keywords: Kids, Sleep, Light, Textile, Design, Interactive.

1 Introduction and Objectives

The initial idea for this project arose after understanding that children's sleep cycles are very different from adults and by identifying their fear of darkness and loneliness when having to sleep in their own beds. Thus, the need was identified for an interactive object that would ease the transition from the parents' bedroom to their own bedroom, as well as keep the child calm if they were to wake up earlier than expected. A focal point was to understand the children's routine, their sleeping habits and their likes and dislikes as well as understanding what are the parents' views and difficulties during the transition, along with identifying what factors could contribute to a better nighttime experience for the family.

Based on Oliveira, a baby's or child's sleep cycle is very different from that of adults. Babies have two states of sleep: the active (EM) and the quite state. During the first nine months of life, each cycle lasts about 50 to 60 minutes. Both states of sleep are very light when compared to an adult, which is the reason why babies wake up so easily.

As the child grows the sleep cycles lengthen, nevertheless they do not last longer than 100 minutes until schooling age is reached [1].

The objectives derived from the research became clearer as the initial studies progressed. The main objective was to develop a product that would propose a balance between creating a calm environment, entertainment and a fun and safe human interaction. It was also crucial to focus on the aesthetics of the product, as it had to be functional but also assume a more decorative function during the day. It was important that the product would be able to transition from a simple nightlight to a more complex piece of decoration allowing the panel to be used even after the child has grown. According to Kazazian everyday objects must change radically to become more efficient, satsifying the need for products with longer life cycles and that are increasingly more sustainable [2].

Consequently, functionality was incorporated with design to develop an interactive artefact that combined electronics with visually attractive textiles, colours and shapes where sustainability was always considered. Product use was also taken into consideration, with the product being activated only when the child is awake, by inclusion of sound and movement sensors used to detect activity.

2 Colors, Shapes and Safety

Colour can be considered a form of non-verbal communication, suggesting a spectrum of emotions varying from culture to culture, for example white. In the western cultures, white is associated with peace, fertility or religion while for other cultures i.e. Hindu's, associate white with death.

França, and Spinillo explain that colour is one of the principal acts towards communication with children and it has a pivotal role in a purchasing environment. Generalizing, children like colours such as reds, yellows and greens, in this order of preference. A study showed that children have a preference towards warm colours; these portray strength, vigour, energy, joy, emotion, sentiment, aggressiveness and even nervousness[3].

Form, just like colour, has visual impact and influence. Again, França, and Spinillo, explain that shape can also be associated with affectionate values and these can derive from three basic shapes: the square, the circle and the triangle. Rounded shapes are associated with positive sensations like protection, peace and cold colours like blue. Similarly, the square transmits sensations of tranquillity and stability [3].

Concerning safety, it was identified that the interactive panel could not have small visible pieces that could easily be broken off and swallowed [4]. It was also indisputable that the existence of visible electrical cables and strings had to be avoided. APSEI adverts that all electrical installations must be, at all times, in good condition and that no electrical cables can be stuck under household appliances or furniture, nor should these have knots along them [5].

As this product is electricity dependent and generates heat it was crucial that the materials used were flame retardant. The textiles used should also have hypoallergenic properties.

3 Development

3.1 Research Methods

The first step was to adapt the product to an infant market segment. To improve our knowledge on infants and their needs, it was necessary to interact with them in first hand. For this purpose, a visit to Fraterna was organized. Fraterna is a community centre dedicated to solidarity and social integration in Guimarães, Portugal, where children between the ages of 1 and 5 attend the day centre. At the institution, we held an informal discussion with both the students and teachers to better our understanding of children's sleep routine and preferences regarding colours and shapes.

It was crucial to identify colours that the children liked but also ones that transmitted a sense of tranquillity and calmness to facilitate naptime.

A questionnaire was also developed and distributed to parents or guardians of children between the ages of 1 and 5. The results aided in the comprehension of the sleeping habits, likes and dislikes of children in general and how much parents would be willing to spend on this kind of product.

3.2 Prototype

The prototype consisted of three parts; the basic structure, the electrical circuits and the textile-based cover (see Fig. 1).

The basic structure, first layer, was made in MDF, Medium Density Fibreboard, which served as the support system for the electrical circuits. It was imperative that the circuits were fixed in a permanent position to prevent damaging or loose bits that could easily be swallowed. The second layer is a small frame like structure used to create distance between the LED's and the fabric layer, which is the third layer.

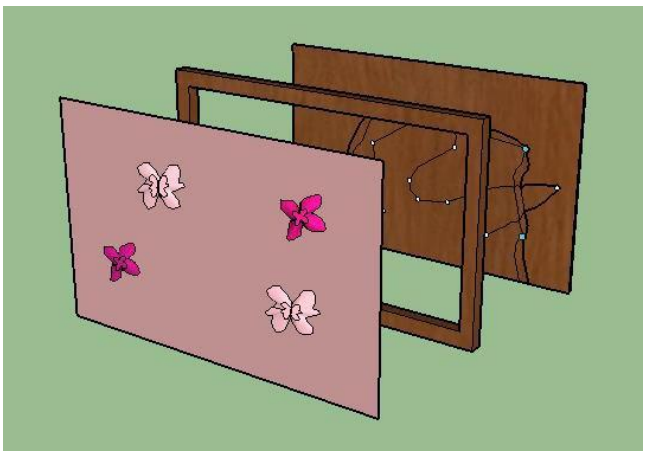

Fig. 1. Prototype mock-up

The electronics used an Arduino Uno microcontroller, WS2813 individually addressable LEDs, and a sound sensor board (see Fig. 2). For movement detection, a Velostat-based force sensor was used. Velostat is a piezoresistive polymer sheet with which it is straightforward to construct simple force sensors. For motion detection, the Arduino firmware monitors the force signal to detect variations.

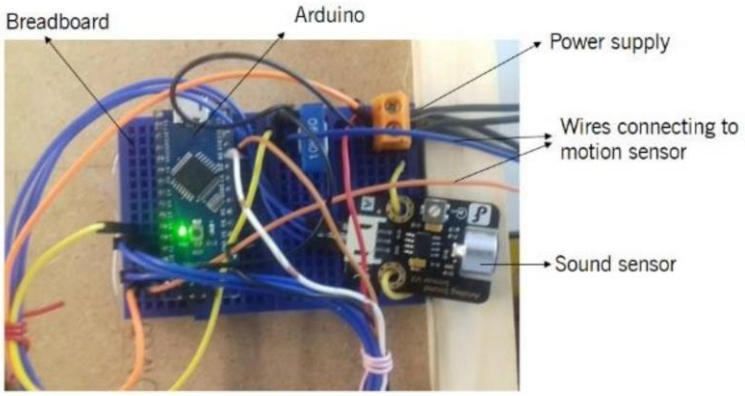

Fig. 2. Electrical components

Besides the Velostat layer, two conductive fabric layers are necessary to serve as electrodes, one at each side of the Velostat. Connections were hand sewn with conductive thread in such a way that the electrodes would not touch directly (see Fig 3.a).

The assembled Velostat piece was covered with a polyester fabric and placed in the child's mattress to detect movement. The sound sensor was placed in a fixed position inside the panel in order to detect the child crying.

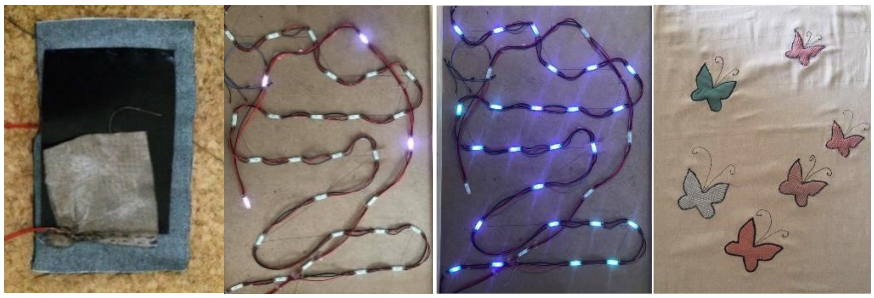

Fig. 3. From left to right a) Force sensor, b) Illuminated circuit activated by the sound sensor, c) Illuminated circuit activated by the force sensor, d) Front view of the panel

The LEDs are attached to the MDF panel and arranged according to the butterfly and star designs. 35 LEDs were used in total, where 6 of them represent the butterflies, activated by sound (see Fig 3.b) and the remaining 29 represent the starry sky, activated

movement (see Fig 3.c). The LEDs are connected to the Arduino microprocessor that is attached to a breadboard located in the bottom right corner of the panel.

The textile layer is composed of a raw cotton base where butterfly designs were embroidered. The butterflies are composed of polyester wadding and Trevira CS, 100% polyester (see Fig 3.d). This fabric was developed by Philips® for lighting panels [6].

The fabric possesses anti-flame finishing and light diffusing characteristics essential in meeting the objectives and specifications of this project.

The wadding used is also 100% polyester and serves as a filling, aiding in the diffusion of light throughout the butterfly design. (see Fig. 4).

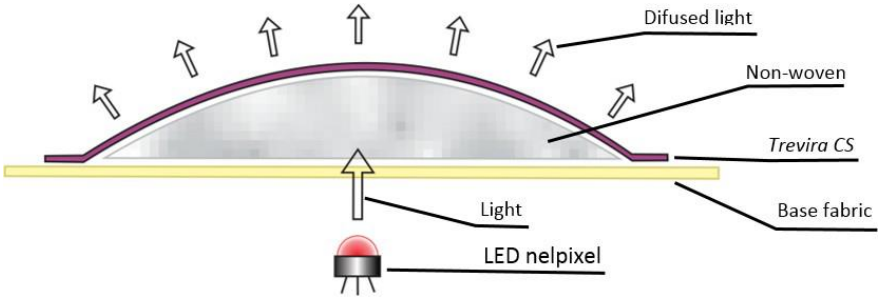

Fig. 4. Cross-sectional view of the butterfly design

The butterflies are illuminated assuming the colour of the fabric behind the white light emitted by the LEDs. Two butterflies light up at a time, from the bottom of the panel to the top, to create the impression of movement and the butterflies flying away. The stars light up in a random way, considering both the LEDs that are lit, as well as the colour in which they are lit, emitting a slow light that fades in and out to create the impression of a starry sky.

The outer case, where the butterfly designs are sewn on, is fully composed of textile and thread and held in place in the panel by elastic ribbon fixed around it. This allows for an easy removal, easing cleaning. The case covers and protects the electric circuits and allows easy access to the components in case any maintenance is necessary.

The panel is to be firmly wall mounted out of the child's reach, as the interaction is solely visual.

4 Results and discussion

By detecting the sound of a child's cry and instantly lighting up the butterflies as a form of entertainment, as well as reacting to the baby's movement in bed, the initial intent of interaction of this project was achieved (see Fig.5).

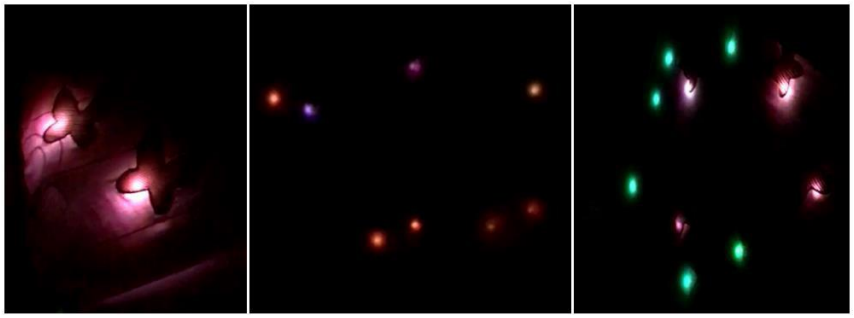

Fig. 5. Lighting effects created by the working prototype.

Even though the prototype uses wires to connect to the force sensor, which was identified during the research as something to avoid, this should not happen in the final product. The prototype was intended to showcase the idea through a working model.

For the actual product, wireless technology would be used, such as Bluetooth or Wi-Fi, which would relive the panel of the exposed wiring, enhancing safety. Furthermore, the panel was subjected to tests to analyse its functions and how both children and their parents reacted. At first, the lighting panel was tested by a five-year-old girl to test the sound system (Fig. 5).

The panel was the exposed during Gnoc Noc exhibition in Guimarães (2017), in a small room with dim lighting. For the exhibition, the Velostat sensor was placed in a pillow that the children could press and instead of crying we asked the audience to clap (Fig. 6).

Fig. 6. Noc Noc exhibition in Guimarães.

During Gnoc Noc the product was tested by children between the ages of 4 -10. The event lasted two days and on average 25 children per day tested the panel for 8-12 minutes each.

The results achieved were satisfactory as both children and parents demonstrated great enthusiasm when interacting with the panel.

5 Conclusions

In this project, using methodologies from both design and technology areas, it was possible to develop a product with practical and commercial interest. Using knowledge from multiple areas of study, creativity and innovation, a product that can enhance the home environment and everyday family life was developed.

We believe this product to be more than a simple decoration artefact due to its functionality. It became more than a simple piece of decoration, as it is capable of identifying sound and movement, and translating them into aesthetically pleasing luminous effects, presenting itself differently each time, through either a shift in hue or the lighting sequence.

Once complete, the prototype was subjected to testing which leads us to conclusions regarding how the lighting panel could be improved. The most obvious improvement would be the inclusion of wireless communication. This would not provide a safer product, considering the link between force sensor and controller. Moreover, a mobile phone app could allow the panel to be remotely controlled, or even to emit alerts when the child wakes up or cries.

There is also the need to identify or develop a different fabric to use other than the Trevira CS, due to its cost. The idea would be to reduce costs of production without compromising the function, aesthetics or safety of the product.

Nevertheless, the results were very satisfactory. Further development involving teamwork between designers and technologists can improve and enhance this product and certainly lead to ideas for new products in which the synergies between these two areas can be fully explored.

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References

1. Oliveira, K., 2015. Entenda como funciona o sono do bebê, https://pediatriadescomplicada.com/2015/03/16/entenda-como-funciona-o-sono-do-bebe, last accessed 2016/11/16.
2. Kazazian, T., 2005. Haverá a idade das coisas leves – Design e Desenvolvimento Sustentável, p. 10. Senac, São Paulo (2005).
3. França, M. S., Spinillo, C. G: Cores e formas na estamparia infantil: a criança como usuário participativo. In: 7º Congresso Brasileiro de Pesquisa e Desenvolvimento em Design, Curitiba (2016).
4. Silva, F. P., Nunes, V. A. V.: A questão da segurança no vestuário infantil. In: VII Colóquio de Moda, Maringá (2011).
5. APSEI, Segurança em casa, https://www.apsei.org.pt/areas-deatuacao/cidadao/seguranca-em-casa, last accessed 2017/03/21.
6. Philips - Luminous textile with Kvadrat Soft Cells, http://www.light- ing.philips.com/main/products/luminous-textile, last accessed 2017/01/03.