An Interactive Playmat to Support Bonding between Parents and Young Children with Visual (and Intellectual) Disabilities

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Abstract

How can a caregiver contribute to secure attachment in a playful manner when the infant is blind or has visual (and intellectual) disabilities? This paper describes the design and development of an interactive playmat to contribute to this bonding process by stimulating sensitive mirroring behaviour of the parent. The motivation for developing the playmat is discussed, followed by an overview of the collaborative developmental process. An iterative co-creation process involving researchers from various disciplines, professional designers and focus groups was used; several test phases with target users took place. This paper describes the starting point from which the process was commenced and the following three iterations. The third iteration is worked out in full detail, including: sensor technology, technical drawing of the product, textile selection, electronics and software, as well as casing design and connection.

Playing with the interactive playmat goes as follows: parent and child are facing each other, sitting or lying down next to the mat. The young child with visual disabilities starts exploring the mat and presses deliberately or accidentally on one of the four coloured tiles, which enables a (previously set up) sound. The parent vocalises and copies the child's behaviour, which supports the cycles of communication between them. Together, parent and child explore the interactive playmat. The playmat not only makes sound, it is also stimulatory in the sense that it is made out of different textures, which promotes the curiosity of the child even more.

In the discussion, the product is reflected upon and the collaboration in the iterative collaborative process is reviewed. Both parties gained much knowledge and enjoyed working together. The planned field study is described: the interactive playmat will (in the upcoming months) be tested on twelve parent-infant dyads. The paper is concluded with the expected implementation of the interactive playmat.

Keywords

Multi-disciplinary Collaboration; Young Children with Visual Disabilities; Attachment; Smart Textile; Soft Technology.

The development of young children is related to a secure attachment relationship with their caregivers. When a child feels secure, his/her development will be positively influenced and the child can learn to regulate his/her emotions. This is the same for children with visual (and intellectual) disabilities. The parent functions as a secure base and safe haven for the child when (s)he mirrors and articulates the emotions of a child in a sensitive way (Dekker-van der Sande & Sterkenburg, 2016). The question that arises is: how can the caregiver contribute to secure attachment in a playful manner when the infant is blind or has visual disabilities?

The challenge was to develop a platform for interactive play that stimulates sensitive mirroring and thus secure attachment of the young child with his/her caregivers. During sensitive mirroring the parent is aware of the own 'inner world' of child, which differs from the parent's. The parent tries to understand this inner world of the child and react adequately (Dekker-van der Sande & Sterkenburg, 2016). However, mirroring of children with visual (and intellectual) disabilities can be a challenge. For the parents, the emotions and the behaviour of the child can be difficult to interpret. Parents of a baby with severe visual disabilities or a baby that is blind, have to learn to understand the body language and the hand gestures that their child uses to communicate (Loots, Devisé, & Sermijn, 2003). Furthermore, with children with an intellectual disability, the developmental age should be taken into account. Much repetition is needed for learning. The mirroring of the child should be done in a simple and concrete manner (Feniger-Schaal, Oppenheim, Koren-Karie, & Yirmiya, 2012). The aim of this study was therefore to develop a platform that supports parents in sensitive mirroring of the behaviour and emotions of young children with visual (and intellectual) disabilities.

The downside of the use of toys when playing with children with (visual) disabilities is that almost all toys promote individual play (Manojlovic, Boer, & Sterkenburg, 2016). Furthermore, professionals stated that "during therapy sessions it is difficult to find interactive, challenging and, at the same time, age-appropriate products that facilitate bonding" (Manojlovic et al., 2016, p. 6). Progress is being made: the VIPP-V (Platje et al., 2018) and the biofeedback system (Frederiks et al., 2015; 2019) both make use of technology to promote bonding and are tested for sensitivity and responsiveness of parents for young children and persons with visual and intellectual disabilities. However, at this moment, there is no specific intervention known that uses technical tools to help mirror emotions. Therefore, the research question of this paper is: how can we improve the interactive playmat (developed for a child with Down Syndrome by Manojlovic et al., 2016) to be able to support the bonding process (through mirroring) between young children with visual (and intellectual) disabilities (age six months up until three years) and their parents?

Overview of the Co-Creation Process

With the development of the interactive playmat, a Research Through Design approach was used (Toeters et al., 2013; Zimmerman et al., 2007; 2010). The main steps included: developing a concept and prototypes, several iterations of usability testing with the focus group (parents and their young children), followed by reflection and re-design.

The first meeting of Sterkenburg (one of the authors, psychologist at Bartiméus, a Dutch organisation providing care and advice for people with visual disabilities, and professor at the Vrije Universiteit in Amsterdam) with Manojlovic (then: graduate student in Product Design at the University of Southern Denmark) was on February 2nd 2015, where design guidelines were determined.

Manojlovic presented six concept ideas on March 4th, 2015 (Manojlovic, unpublished):

- Rotating Light Stick: parent and child turning the stick (each person on one end) will change the colour.
- The Drum Playground: copying each other's behaviours while drumming on a playmat.
- The Interactive Sock: interactive puppet socks on hands of both parent and child.

- Matching Suits: vibrating suits with touch patches.
- Interactive Cubes: magnetic matching cubes.
- Choreographic Carpet: interactive carpet that detects human movement.

The first iteration resulted in the Drum Playground and the Choreographic Carpet being further developed into the first prototype of the interactive playmat, that was tested during interaction of a child with Down Syndrome and her parents in 2016 (Manojlovic et al., 2016; see: 'Starting point'). The idea of an interactive playmat was tested on a focus group with different stakeholders in the care for young children with a visual impairment: a developmental and child psychologist, a physiotherapist specialized in child-care and a family therapist. Next, the second prototype was a game or toy for promoting bonding of the child with visual (and intellectual) disabilities and their parents. This prototype was a result of several activities. First, ideas from the focus group were gathered by sending out a short questionnaire to therapists and early-intervention workers at Bartiméus, with the aim to learn more about child-parent bonding of children with visual disabilities.

During the survey, the following questions were asked (in Dutch, this is a translation):

- What techniques do you recommend for parents to work on the bonding with their child with visual disabilities?
- To what extent do you think it is possible that bonding through playful interactive mirroring (copying each other's behaviour) is possible for children with an intellectual disability?
- What way of playful interactive mirroring would be most effective for children with visual disabilities? (Think of: parroting, copying movements, touch, etc.)

Inspired by the answers of the focus group, ideas for playful interactive mirroring games came to mind and were put to paper:

- Music playmat: parent and child make music together.
- Theme mat (seasons): for example creating an autumn sensation with different textures, sounds and smells.
- Sweater for a parent: stimulating touch by giving the child feedback by means of vibrations or sounds.
- Puzzle mat (doors): engaging the child in play by combining storying telling and puzzling, every piece containing a story, emotion or scent.
- Follow game: large playmat with parent and child locating sounds together.
- Step spring: connecting parent and child to each other via a vibrating, light-emitting step spring.
- Bouncing game: throwing and catching of a digital LED ball on a playmat.

Then, the focus group gave feedback on these ideas via an expert meeting. Next, the project group came up with a number of design requirements for the interactive playmat with the aim to encourage the parents in sensitive mirroring of a young child with visual (and intellectual) disabilities. For the third iteration, several sensory stimulating toys were reviewed. At this iteration, a prototype of the interactive playmat for young children with visual (and intellectual) disabilities was created and tested on one parent-child dyad. The parent was asked to give feedback on the interactive playmat. After the second iteration, Toeters (one of the authors and owner of by-wire.net, professional design and research studio for fashion technology) took over the challenge of further developing the interactive playmat.

With this interdisciplinary inquiry, a solid working relationship came to be between the designer (Toeters), the researchers in designing interactive systems (Baars and Barakova) and the scientific practitioners (Dekkers-Verbon and Sterkenburg). Multiple meetings were held and the scientific practitioners visited the design and research studio several times. Also, this paper was simultaneously written by the authors from all disciplines, with the use of digital document sharing.

Starting point

The first prototype of the interactive playmat, made from fabric, was based on positive and multimodal stimulation and it registered movement. The soft part of the platform contained sensors and actuators: one buzzer and two luminous rings (see Fig. 1). Parent and child took place opposite to each other and the game went as follows: the buzzer played a high-pitched melody to draw the parent's and child's attention so they would focus on the textile mat. After a two-second break, the two rings emitted light (Fig. 2). The idea was that parent and child with Down Syndrome reached out towards the lights, thereby making the same movement and thus playful mirroring would be stimulated (Manojlovic et al., 2016).

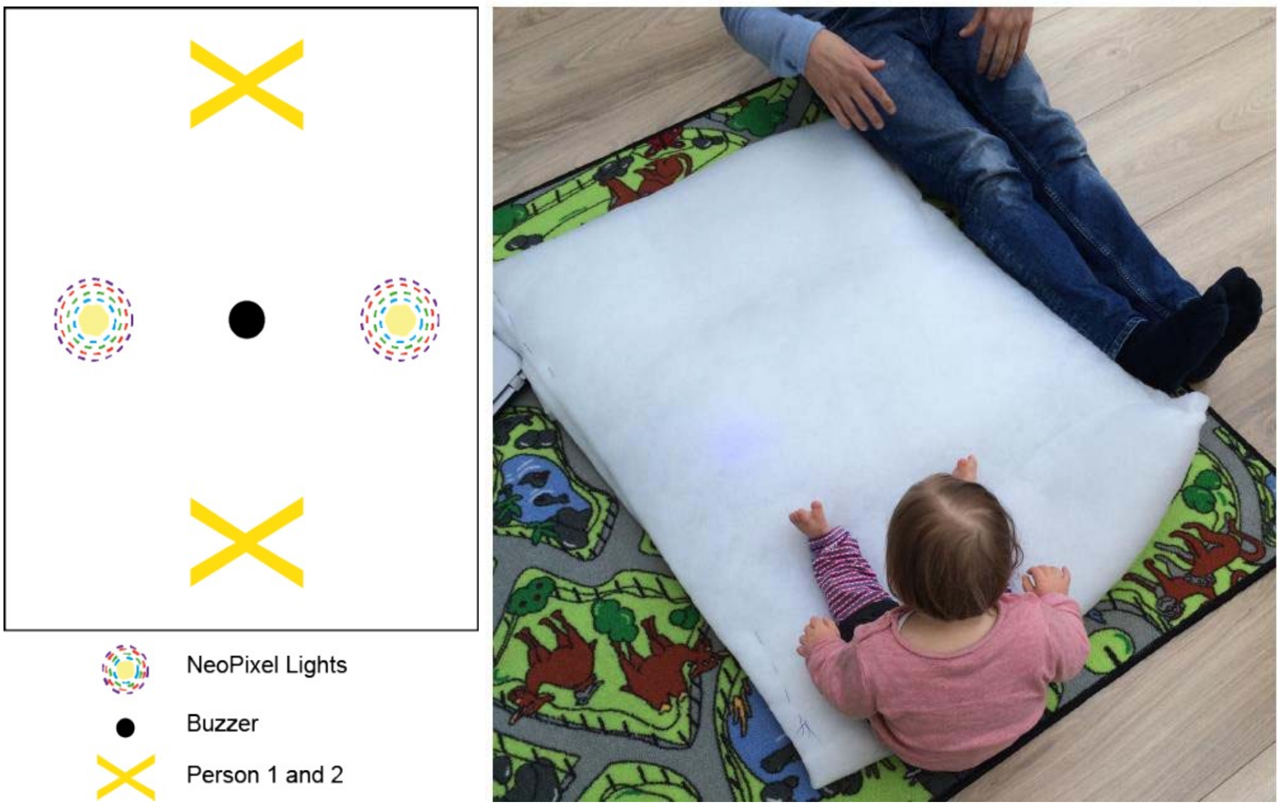

Fig 1 and 2. Interactive playmat developed by Manojlovic et al., 2016.

The prototype was tested by a family with a two-year-old girl with Down Syndrome. Her parents were enthusiastic about the use and possibilities of the playmat in terms of discovering and playing together with their child. The authors claimed "…a form of mirroring was indeed taking place in interaction" (Manojlovic et al., 2016, p. 5). However, there were also limitations to this prototype. It was conceived to be difficult for the child with visual disabilities to perceive the displayed lights. The advice was to continue developing the playmat in such a way that it turns out to be more suitable for children with visual disabilities. Furthermore, the authors concluded that it is important "to understand how professionals would experience such activities and environments, what would inspire them and what would be their concerns" and that the early-intervention workers specialized in visual and hearing disabilities should be kept involved in the follow-up on the research (Manojlovic et al., 2016, p. 7).

First Iteration

After the exploratory phase, Baars and Barakova designed a prototype of the interactive playmat for young children with visual (and intellectual) disabilities, with the size of a pillow. This first prototype consisted out of twelve touch-activated tiles, each with a unique texture (Fig. 3). Next, the first prototype was evaluated. Baars watched documentaries where children with visual disabilities interacted with their parents, with the purpose to learn more about the children's development and interactions. She also received feedback from three industrial design coaches who suggested using instrument chords so parent and child could compose a music melody together. Baars also gained input from different experts at Bartiméus: Sterkenburg and three early therapeutic counsellors gave advice. Baars then visited a therapeutic toddler group from Bartiméus where she observed the children and she spoke to the counsellors about the playmat. Besides stressing the importance of the mirroring movements that should be triggered by using the interactive playmat, the feedback of the focus group implied it would be "interesting if the parent was able to record their own sounds and link them to a square" (Baars, unpublished, p. 14). Also, the focus group highlighted the significance of engaging the remaining visual abilities of the child. Furthermore, the playmat was believed to be too small to stimulate the gross motor movement of the children and the tiles were difficult to activate for small children (much pressure was needed).


Fig. 3 and 4. Respectively first and second prototype (photos taken by Baars).

Second Iteration

With the focus group feedback, the next prototype was developed (Fig. 4). This prototype was a floor playmat to enable children to make larger movements and facilitate mirroring behaviour. The squares were changed into contrasting colours with clear borders. This was done with the idea that children that have remaining eyesight might be able to differentiate between the various patches on the playmat. For the second iteration, four coloured squares with very different feel were stitched on to white surface: purple wool, yellow fleece, ribbed blue and orange velvet. The activation of the tiles was simplified: they could now easily be activated by hands or feet. The sounds coming from the playmat were changed to piano chords that were emitted from a small speaker coupled to the interactive playmat.

Next, a usability study was performed during two test runs with a toddler with visual disabilities and her mother in their natural environment (their home). The mother and her child played vigorously with the mat and clearly enjoyed it. Mirroring behaviour was observed on multiple occasions (Baars, p. 21). Due to the external sound source, the child focussed outside of the mat multiple times (as to where the sound originated from). Afterwards, Baars conducted a semi-structured interview of the mother. The mother claimed that by using the playmat, they came up with new games that they otherwise would not have thought of. The mother felt that, although she thought a strong point of the playmat were its contrasting colours and different materials, the contrast of the colours should be increased even more. The interviewed mother said that she would prefer using the playmat together with the therapeutic counsellor, because the counsellor can explain the benefits of playing in this (mirroring) way. The mother proposed to give every square its own speaker so the sound comes from the tile that is pushed upon. Furthermore, the sounds were perceived to be too similar. Modularity in terms of sound would be welcome to ensure long-term use. Another wish was the use of sensors without the necessity to attach a computer. Last, the washing of the playmat was a problem due to the electronics wired inside the mat.

Third Iteration

Toeters took over the development of the interactive playmat. The recommendations coming from the observations and the interview were taken into account when developing the third prototype (Fig. 5 and 6). In this prototype, the speaker was embedded into the interactive playmat to prevent the child from focussing outside of the mat. With the purpose of increasing the contrast even more, the yellow square was switched to green. Furthermore, the sounds were changed to animal sounds and can be adjusted repeatedly. The total sensing and interactive system were integrated in the playmat, so it became a standalone product. The sensors are washable and integrated. In this third prototype, the sound box was made separate (see also Figure 12-15). Only the box needs to be removed before washing.

Fig. 5 and 6. Third prototype of the interactive playmat for young children with visual (and intellectual) disabilities.

Sensor Technology

In the third iteration two layers of Velostat were used, that sandwich a layer of fiberfill (Fig. 7). Velostat is a pressure-sensitive conductive material: squeezing it, will reduce its resistance. This change in resistance can be measured so that it becomes a flexible sensor of the pressure. Velostat is washable and can be used for large surfaces. The used sensors are square surfaces of 30x30 cm. Fiberfill is another synthetic material used for padding and insulation in garments and soft interior products such as carpets, cushions and duvets. When touching the playmat, this material makes sure that the changes in resistance increase. On two opposite corners (diagonal), a conductive wire is connected via zigzag stitches (Fig. 8).

Fig. 7. The layering of the sensor technology.

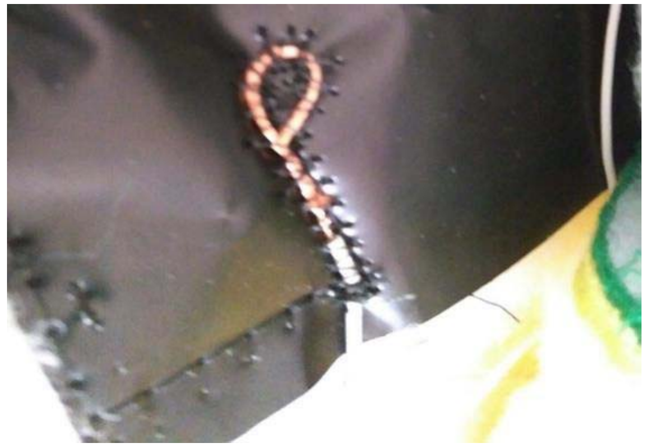

Fig. 8. Electric wire connected to Velostat.

Technical Drawing of the Product

The playmat is 120x120 cm and split into different blocks (Fig. 9). Four blocks include the sensor technology as described above. The seams are positioned to guide the conductive wires (displayed as yellow lines in the technical drawing).

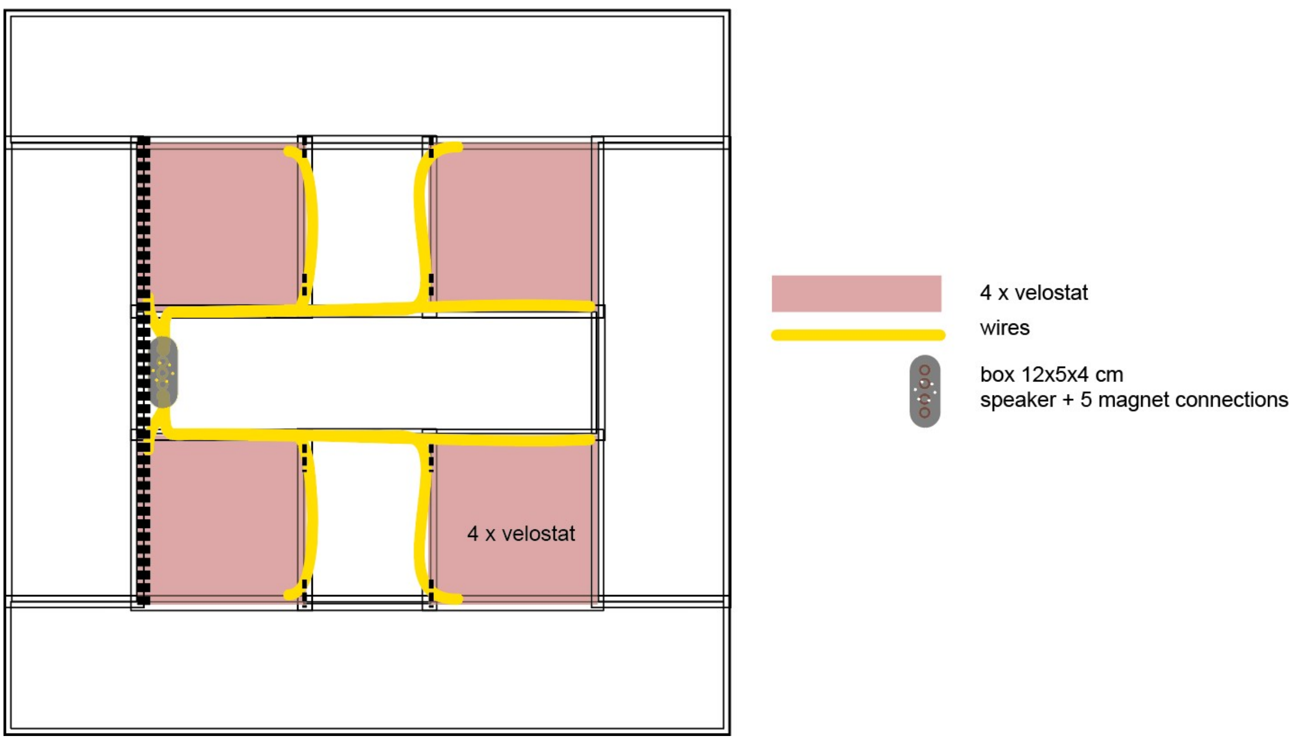

Fig. 9. Technical drawing of the positioning of the sensors (wires and Velostat) and actuators (sound box).

Textile Selection

The base of the playmat is yellow cotton (kau 07) and fibrefill over the full width. The fibrefill is the same as used as spacer in the pressure sensors. The four patches are sewn into it. The textiles were selected because of their high contrasting colours and for the contrasting tactile experience when touching them. The selected combination is: Hydrophilic Green (HYD-11), orange fabric with palettes, Velours Lycra in red (vel.01) and petrol blue fake fur (bont 26).

The contrast between the colours makes it easier for children with visual disabilities to discriminate the various parts of the playmat, which stimulates the exploration of the playmat. The texture differences create extra dimensions in terms of stimulating the senses of touch and sight of the young child. The participant in the pilot test (ten-month-old baby) was especially drawn to the orange glitter fabric and the blue fur like fabric.

Electronics

Within this third iteration, we especially iterated on the electronics part via a trial and error approach. Based on the second iteration, the following electronics were used: Arduino Uno R3, small speaker (SPKR3W4O) and an MP3 module named DFplayer-mini with a micro SD card. An MP3 module (actuator) was used to create different sound feedback when different tiles were being touched (sensory input) and was linked to the speaker and the board. This system can detect when different tiles are touched and responds with the desired sound signal. When more than one tile is being touched, the highest registered value overrules the other signals. The CapacitiveSensor.h library was used for this. With the micro SD card as input, it is easy to change the sounds uploaded to the module, corresponding to the liking of parents and child. The DFRobotDFPlayerMini.h library was used. For the current iteration, all components needed to be integrated in the mat itself, therefore it was necessary to downsize all the electronics and also integrate the power source and a switch in the system.

Firstly, the board was replaced with the Pro micro 3.3 Volt. This system had problems with the analog sensor readings - it worked well with a single sensor, but had problems with measuring the four sensors in parallel. Several other low voltage boards were tested, but installing the sensing and actuation software program was problematic.

The final choice was Arduino Nano, which is small in size and able to measure all four sensor readings. This board can be seen in Fig. 10-11. A trade-off in this board is that it needs 7 Volt power supply, while the total system is designed to work on 4.5 Volt. So, a 9 Volt battery had to be added and the total system plus the shape of the controller box needed to be adjusted to this change. With each adjustment, the controlling program also needs to be adjusted.

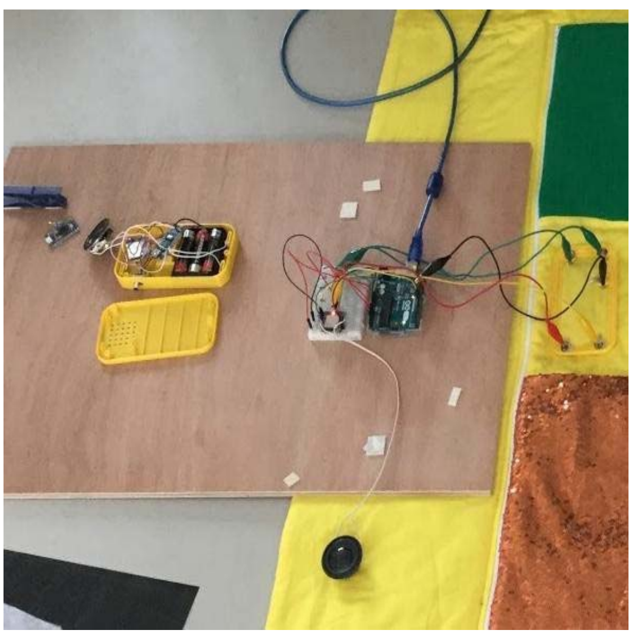

Fig. 10. Playmat connected to temporary board.

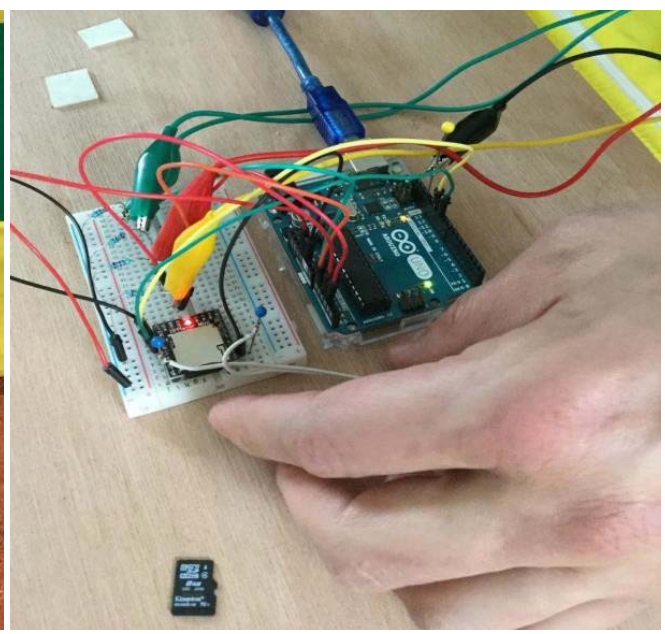

Fig. 11. Detail: changing the SD-card (temporary board in use).

Software

A finding during the programming process was that there is a problem with the Arduino UNO ADC that affects other boards as well. Multiple analogRead() performed on different pins with no delay will not give enough time for the ADC to “cool down” and measurements will be completely incorrect. The Arduino community came up with a solution for this problem: perform two analogRead() on the same pin, dump the first and keep the second. The digital to analog converter

(DAC) is done twice in sequence so that the first measurement resets the measurement and the second one does the actual measurement.

Here you can find how this is programmed for sensor two:

```
Blauw = analogRead(Sensor2);
 delay(50);
 Blauw = analogRead(Sensor2);
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3D printed casing design

In parallel, while repeatedly adjusting the electronics, the casing had to be redesigned and reprinted (Fig. 12-15). Some functional aspects (such as size, sound transport and position of the switch) and aesthetical aspects (like rounded corners, height, colour and position of the magnet connections) were taken into account. This binary approach gave a nice fitting result to the total project. Our pilot tester (ten-months-old baby) found this piece very attractive and interesting.

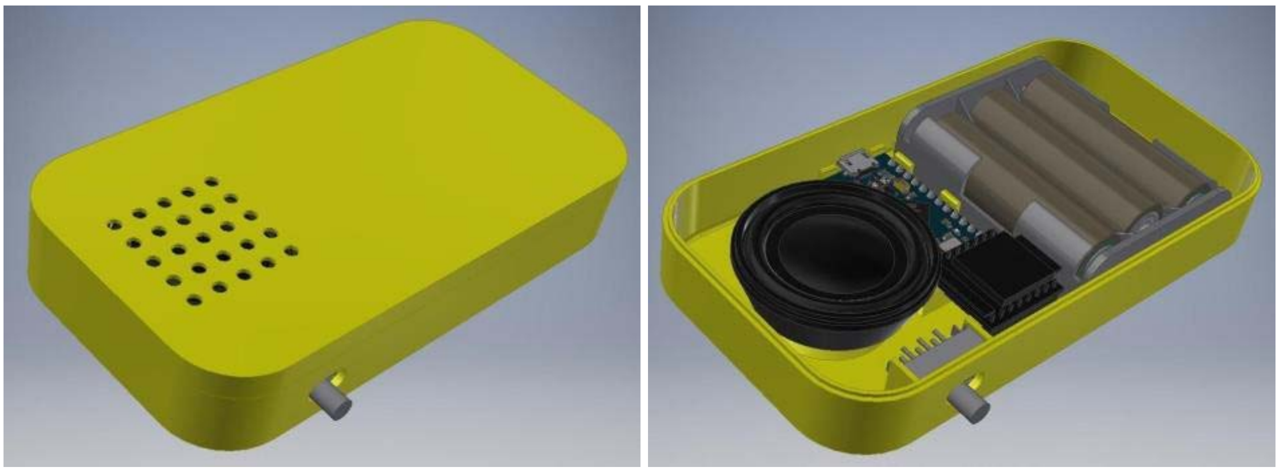

Fig. 12 and 13. 3D rendering of the casing design, closed and open.

Fig. 14 and 15. Actual print of the casing, with all electronics integrated.

Magnet connection

To increase the user experience, magnets were used: magnets guide the user (e.g. a parent or early-intervention worker) towards the correct positioning of the casing on the playmat. Magnets also make it easy to connect and disconnect the casing (for example for washing and charging).

Furthermore, magnets have long durability. In a vertical position, five magnets were integrated in the case. These magnets are connected to the motherboard in the case. Five metal rings were placed in a horizontal position on the mat (Fig. 16). These rings are connected to the sensors. The rings and magnets exactly fit together.

Fig. 16. Five magnetic connection points on the interactive playmat.

Discussion

Related Projects

The implementation of electronic textiles (e-textiles) is quickly advancing. Learning, discovering and sharing how to design e-textiles is nowadays incorporated in the education of industrial and fashion designers to be (Coleman et al., 2011). Examples of e-textiles are: a shirt that can take an electrocardiogram, a dress that can warm a painful back and a shirt that turns sunlight into electrical energy while wearing it (Toeters, 2016). With e-textile, the digital and physical world can be linked. For example by telling stories with augmented reality: digital story tale figures hidden in a pillowcase and blanket are made visible by an iPad to let bedtime stories come alive ('Textales') or QR-coded embroidery on a skirt is connected to a folklore tale (Kuusk et al., 2012; 2013; 2016).

The overall use of interactive technologies that promote social bonding and interaction is rapidly increasing (Barakova et al. 2013; Brok & Barakova, 2010; Frederiks et al., 2019). An example of social e-textile is a scarf designed to move on the rhythm of the elevated heartbeat to help a shy person become aware and express his/her feelings of excitement or arousal (Daems, Toeters & Feijs, 2015). Likewise, a sleeve "to let elderly in rehabilitation feel connected to their family at home and to give them more insight into the rehabilitation process" (designed by TU/e student Van der Voort, mentioned in Toeters & Brinks, 2012, p. 5). Moreover, innovative ideas in the form of e-textile are also being implemented in healthcare. For instance, an exercise glove that helps people with hand-arthritis (designed by Wagner and Schneider, mentioned in Toeters & Brinks, 2012, p. 4), a vibrating strap for people with Parkinson Disease (designed by Mangre, mentioned in Toeters & Brinks, 2012, p. 5) or Vibrating therapy integrated in a shirt to treat osteoporosis (Bhömer, Jeon

& Kuusk, 2013; Kuusk, 2016, p. 75-79). Also in the care for people with disabilities, e-textile is being used: for example, a bio-response system integrated in a sock so to measure stress levels of a person with severe disabilities, with the purpose to alert a carer even before changes in behaviour are visible (Sterkenburg et al., 2017).

The current study features an iterative research through design approach that aims at developing an interactive product that will improve the social well-being of a sensitive user group, namely infants with visual (and intellectual) disabilities. While interactive products designed for young children with developmental disabilities (Brok & Barakova, 2010; Huskens et al., 2015), or for adults with similar disabilities as in the current user group (Frederiks et al., 2019) were shown to be well accepted, little research is done on what kind of product is suitable for infants with visual disabilities. The pilot tests performed during the design iteration showed that the children were positively engaged and excited when interacting with the playmat. However, the performed tests included few participants and no test protocol was used. In addition, the developed system is a prototype and does not work flawlessly yet. Below we address the planned steps for further improvement of the interactive playmat and its usability testing.

Reflection on the Product

First, we plan to perform an observational study with four infants (without visual or intellectual disabilities). This user study will be done not only to fine-tune the setup of the future field study, but also to adjust the settings of the interactive playmat in terms of sound volume and sound timing.

Whilst testing the playmat, there are still some improvements to be made in terms of the textile pieces and the hardware fine-tuning. First, concerning the textile pieces: the replacement of the zipper so that children and parents cannot (accidentally) open it; and redesigning of the pattern parts for placing of the pressure sensors efficiently during production. Second, concerning hardware and software fine-tuning: the improvement of the energy efficiency; determining the size of the total box; usability improvement (for example easy replacement of the battery); and improving the reliability of all technological components.

Collaboration in an Iterative Process

In the context of the theme EKSIG 2019 *"Knowing Together – experiential knowledge and collaboration*", we evaluated our collaboration between researchers from different disciplines. In this case, user centred design (ISO 13407:1999) and co-creation/participatory design (Ehn, 1988) were adopted. However, the traditional user-centered design methods and the tools that support them, assume that the design process is well scoped as a project: with a clear separation in terms of organization and expertise between users and the developers. Also, it assumes that the technology developer can plan and shape the product development process and can command the resources necessary for it.

These assumptions are not valid when developing solutions for highly specialized domains and when using non-conventional (also thus specialized) interaction platforms. In such cases, there is a need to pool diverse expertise and resources. While collaborating, all parties continuously learn from the other disciplines: perspectives change and spiralling growth upwards occurs when parties built on each other's knowledge and expertise. To address these problems, we aim for processes where a variety of stakeholders can cooperate in what can be described as a *participatory organization*, i.e. free to contribute or not and without abiding by fixed deadlines (see Spinuzzi, 2005).

Due to the use of this multidisciplinary collaboration approach, this product became rich in functionality and developed as it is now. The user involvement during this iterative approach helped to fine-tune the product towards the target group. Having the expert knowledge of the target group, the developmental psychology expertise of how to motivate play, the design knowledge about interactive textile products and the electrical engineering expertise all on the same page and involved in the same process, brought us valuable results.

The behavioural scientific practitioners (Sterkenburg and Dekkers-Verbon) especially valued this involvement: psychologists and early-intervention workers were repeatedly involved and the design-researchers carried out observations of children with visual disabilities. The scientific practitioners appreciated the hospitable visits to the design studio and especially the patience the designers showed when explaining the technical parts of the interactive playmat. As Toeters quoted Vertooren in 2007: “For a successful collaboration you have to speak the same language.”

The designer Baars benefitted from working in close collaboration with Bartiméus: she was able to make use of their expertise. This resulted in an experiential design based on the knowledge available in the organisation, interpreted from a design perspective. Within this design perspective, different prototypes and iterations were made. At times, this needed to be translated back to the others disciplines involved: communication proved to be very important.

Reflecting together on the intermediate prototypes is essential in such a process. Every party brings their own expertise to the table, which makes reflection fruitful. In this case the designer Toeters learned much about the benefits of tactile diversity during the textile selection process, for example how different textures and colours should be, so that this specific target group would be triggered. She also learned about how to construct the pattern parts so that they would fit the later production processes, which makes the technology integration process easier.

The electrical engineer of by-wire.net experienced difficulties in reading stable sensor data and comparing this data with the data gathered one second ago in four parallel lines. Also, different breadboards acted differently on the exact same program of calculating, because of the variety of chips used on the different breadboards.

Although the authors believe the collaboration during this project was successful, there is always room for improvement. The physical distance between the various researchers was a challenge in the collaboration process. Working together on writing this paper required much planning and therefore time: a quick fine-tuning talk during lunch break was no option. In the process of writing the paper, the authors communicated via email, by phone and through remarks in the shared Google document. WhatsApp messenger was also used; however, a suggestion for future interdisciplinary collaboration is the use of Slack (a collaboration hub) in order to prevent a mix-up of private and professional communication channels. Furthermore, the authors made use of a shared Google document. However, it is preferred to use an independent cloud storage service like SURFdrive to be sure the data is secure and will not be shared with others without knowledge or permission (see also the Google Terms of Service). Unfortunately, using SURFdrive was no option for this research party, as in SURFdrive it is not possible to work simultaneously on the document.

Future Field Study

When the playmat is finished, further testing will be done to underwrite the effect on sensitive mirroring behaviour of parents of children with visual (and intellectual) disabilities. This will be done with a combined-series single-case design study involving twelve child-parent dyads from Bartiméus. Research questions will focus not only on whether parents show more mirroring behaviour, but also on whether the children seem to experience more joy while playing on the interactive playmat, than when they play on the ground or on their own playmat. The expectation is that the playmat will help parents show more mirroring behaviour because the playmat evokes such play. During the whole process of field study and implementation, it is crucial that the researchers actively ask the participating parents for feedback on the interactive playmat and that the researchers keep actively involving the focus group.

Implementation

While the scientific practitioners conduct the field study, the design team will produce twelve playmats. These playmats can then be used during the home guidance given by staff from Bartiméus for parents of young children with visual (and intellectual) disabilities. Also, the interactive playmats will be put into use in the therapeutic toddler group and in the living community of young children with visual (and intellectual) disabilities. If the field study turns out to be beneficial in terms of promoting sensitive mirroring behaviour in parents and/or joy in the children, first steps will be made to make the interactive playmat available for the free market. The playmat can then also be utilized by parents of young children with intellectual disabilities but without visual disabilities.

If in future the playmat can be hung on the wall, it can also be used by persons with a wheelchair and thus with reduced mobility, e.g. people with severe intellectual disabilities and/or the elderly. The playmat is a versatile object: sounds can easily be altered. It can for example be used by persons with (intellectual disabilities and) dementia. An example of an e-textile developed for people with dementia is Tactile Dialogues: a textile pillow that reacts to touch with personalized vibrations. It is used to trigger communication between persons with late-stage dementia and their relatives, by means of joint interaction and mirroring behaviours (Bhömer, 2016, p. 39-51; Schelle et al., 2015). The interactive playmat could be made suitable for persons with dementia by matching the programmed sounds to early memories that specific person has. For example using sea-related sounds such as seagulls and waves for a person who used to stay at the seaside when being a child. Stimulating a person to remember past days is called reminiscence. Reminiscence can improve the confidence of a person with dementia and provide valuable topics to talk about with that person (Maaskant & Schuurman, p. 25). Furthermore, reminiscence can help improve upon social-emotional parameters like depressive symptoms, self-acceptance, relationships with others, autonomy and environmental mastery (Gonzalez et al., 2015). Thus, although the playmat was developed for young children with a visual impairment, the use hereof in future can be implemented in a big range of care.

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