Creative Multisensory Environments

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Abstract

We outline the concept of playful creative multisensory environments. Multisensory environments are characterized by facilitating multimodal interaction by users through a composition of different objects. These objects allow manipulation of the environment. Multisensory rooms are often used to enhance users' sensations and emotions. In order to explore the development of such multisensory environments, which are playful and provide possibilities to become creative, we suggest the use of modular playware as part of the Playware ABC concept. This allows for the development of flexible, portable environments to be used by anybody, anywhere, anytime, and facilitates that the users can construct, combine and create. In this way, the users can become creative in seamless interaction with aesthetically pleasing environments. The paper outlines the lessons learned from the development and testing of a number of such playful creative multisensory rooms. Main findings are that such multisensory environments need to provide explicit immediate feedback, be simple in design, build on high quality aesthetics, provide variation, and be playful to result in intrinsic motivation.

Keywords: Multisensory Room, Snoezelen, Immersive, Playware, Modularity.

1. Introduction

Multisensory environments (or Snoezelen) originated in Holland in the late 1980s at the Hartenberg Institute. The word Snoezelen is derived from the Dutch words for sniff and doze. The aim of such multisensory environments is to induce leisure, enjoyment and relaxation in people through enhancing their sensations and emotions [1].

As a therapy, the environments are used as multisensory therapy, aiming to provide sensory stimulation for people who due to their learning disability would not spontaneously seek such stimulation. The environment prompts sensorial and emotional exploration. This is achieved in a constructed environment, usually a purpose designed room equipped with dimmed lighting various colours, visual displays, fiber-optic lighting, projectors with wheels for wall/floor displays, tactile objects, bubble tubes, olfactory stimulants, equipment for sound production and furnishing to relax on, such as floor cushions and water or air beds [1].

Even when multisensory rooms are used widely in therapeutic settings, there is debate as to whether multisensory environments should be considered a therapy as a primary purpose. Indeed, the original concept opposed the therapeutic framing of the concept and emphasized the aesthetic and playful qualities:

"The emphasis is on the provision of a leisure environment, rather than a therapeutic one, which includes equipment specifically designed to provide enjoyment." [2] When these environments are used with people with cognitive and/or physical disabilities, the original Snoezelen concept outlines the playful enjoyment as the primary aim of the activities (rather than a therapeutic aim):

"When considering leisure activities for people with profound handicaps there is often an emphasis on the learning or therapeutic dimension of recreation; for example, the acquisition of a new skill or the remediation of a behavior problem. The Snoezelen concept, however,

stresses the fact that people with such handicaps have the same right to leisure time as everyone else and, whilst a therapeutic outcome or learning of a skill may arise from Snoezelen activities, the major emphasis is placed firmly on pleasure." [2]

This is in line with work on play and playful environments. Play is defined as a free and voluntary activity that we do for no other purpose than play itself. We do not play to achieve a certain outcome or product, but we play for the pleasure and enjoyment that we feel while playing. Nonetheless, under various circumstances, we may observe certain effects of play. For the one who plays, these effects are not the primary reason to engage in play. Therefore, we term such effects the *collateral effects of play*. The collateral effects of play can be educational achievements, motor skill enhancement, cognitive and physical rehabilitation, etc. These collateral effects of play can be significant and important, but it is essential to understand that play is a self-sustaining phenomenon which carries its purpose in itself. [3]

It is important in the design process to distinguish between (i) the design for therapeutic or educational outcome as the primary purpose, or (ii) the design for play and enjoyment as the primary purpose and therapeutic and/or educational outcome (only) as potential collateral effects. When designing for play, one aims to create user interaction arising from intrinsic motivation based on the enjoyment and free will of the user. The design will be evaluated by its ability to foster this enjoyment and play dynamics of the user. The therapeutic and/or educational outcome takes a secondary role and can/will only be evaluated after the design has been evaluated positively to foster the enjoyment and play dynamics.

These collateral effects of the play and enjoyment can be quite remarkable, and it has been asserted that the use of multisensory environments have positive therapeutic effects on disabled users [4-6]. Kewin [6] suggests that the therapeutic value is recognized in that it is believed to enhance exploration and development.

2. Playful Creative Multisensory Room

In our concept, we aim to develop *playful creative multisensory rooms*, in which we allow the user to become creative in the interaction with the elements in the multisensory room. The foundation of the concept is modular playware and the Playware ABC.

Playware is defined as intelligent hardware and software which aim at the creation of play and playful experiences [7], and hence the playware should work as a play force which pushes the user into a play dynamic. An instance of such playware is modular playware, in which the intelligent hardware and software takes a modular form. Modular playware is described by Lund and Marti [8] as playful modular objects that are visible, manipulable, sharable and interactive and imply construction, active participation, creativity for assembling, mastery of the parts by the users who play with them. These technologies allow a range of play from simple exercise play up to construction play requiring sensory-motor skills as well as coordination/ manipulation of objects.

The *Playware ABC* concept addresses the challenge of facilitating interaction by anybody providing quality of play and its collateral effects for many different user groups. The Playware ABC concept is formed by:

A: Anybody, Anywhere, Anytime

B: Building Bodies and Brains

C: Construct, Combine, Create

The Playware ABC concepts works for creating technology solutions for *anybody, anywhere, anytime* by using embodied artificial intelligence *building bodies and brains*, which facilitates that users can themselves manipulate with the technology solutions to *construct, combine and create* their own solutions. [9]

Modular playware technology can be well appropriated for the Playware ABC, if the modules are designed and developed according to this concept to allow anybody to easily construct and create with the modules. Indeed, Lund and Marti [8] outline a number of design features for modular playware to become flexible in both set-up and activity building for the end-user. Key features of this design approach are modularity, flexibility, and construction, immediate feedback to stimulate engagement, activity design by end-users, and creative exploration of play activities.

The flexibility of the modular playware allows it to be a component for the Playware ABC and for our development of playful creative multisensory environments. The modular approach facilitates the work towards systems that are easy to set-up as environments

by anybody, anywhere, anytime – in contrast to many classical multisensory rooms with a complex installation process, which demands a large infrastructure. The Playware ABC concept suggests that such infrastructure and installation demands may be avoided to a large degree when the starting point of the engineering and IT system design is transformed from the optimal system performance to become a focus on creating a solution that can be used by anybody, anywhere, anytime. [10]

3. Implementations

We have combined different technological platforms to explore the modular playware concept for different user sensory modalities by combining heterogeneous building blocks (i.e. modular playware), creating multisensory environments. For instance, we combined the modular interactive tiles and cubic I-Blocks in the creation of a multi-sensory room in the HC Andersen children's hospital [11], we combined rolling pins and light&sound cylinders in the creation of a multi-sensory room for elderly with dementia [12], and we combined modular tiles, rolling pins, and light&sound cylinders for the first RoboMusic concert [13] (See Fig. 1-3).

These are *playful creative multisensory environments*, which in an easy manner allow any user to become creative with sound, light, visual images, and materials. The manipulation in terms of physical interaction with modular playware components such as the interactive tiles, blocks, pins and cylinders results in creative manipulation of the output modalities of the multisensory environments in terms of sound, light, vibration and images.

Fig. 1. Tiles, rolling pins, and cylinders used for Playful Creative Multisensory Environments for RoboMusic concerts, and rooms for seniors with dementia.

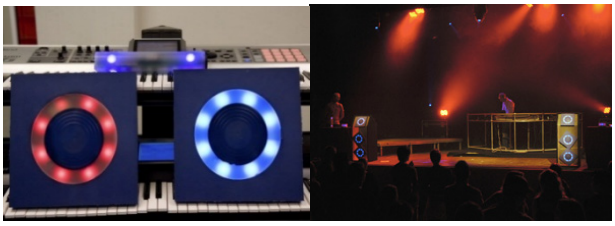

Figure 2. Left: Two Tiles and a RollingPin used as robotic instruments. Right: The RoboMusic live concert set-up, with Funkstar De Luxe and his control station in the center, and the robotic instruments on the left and right side of the stage.

Figure 1 and 2 shows the use of a few such modules for making a Playful Creative Multisensory Environment. The modules were easily set up as a multisensory room in a concert hall for allowing the audience to interact with the live performing artist (see Fig. 2 right). The modular playware technology was further refined a decade later for the interactive live performances on stage by Peter Gabriel. Similar modular playware was adopted to playful interaction as a multisensory room in the HC Andersen children's hospital (see Fig. 3).

Figure 3. An early implementation of a Playful Creative

Multisensory Room in the HC Andersen childrens hospital with a child turning and shaking a cube to create patterns and games on the modular tiles wall.

Some of the lessons learned from more than two decades of research and development of such flexible multisensory rooms relate to the design, feedback, sensory stimuli, variation and playfulness.

- **explicit immediate feedback**: it is important to make the feedback explicit and immediate for the user to appreciate the consequences of the physical actions.
- **simplicity**: the design must be simple to increase robustness and allow for easy set-up anywhere. Also, interactivity should be kept simple for anybody to understand the interaction modalities and consequences within seconds.
- **quality**: the sensory stimuli must have a high aesthetical quality, both for the visual and audio, and games must have a high game quality for users to appreciate manipulation with the objects to construct, combine and create (hence we engage professional artists, musicians, football players, etc. in the design)
- **variation**: it is important the ensure variation for both short-term and long-term interaction. We appreciate such changeability in nature, and can do so also when imposing variation and adaptivity in the multisensory room output.
- **playfulness**: when the system is made playful and the modular playware helps pushing the user into a play dynamic, we observe that the users easily forget fears and limitations, and continue to engage in the environment due to their intrinsic motivation.

4. Discussion and Conclusion

Building on these developments and insights about playful creative multisensory rooms, as artistic and aesthetical expressions, we are suggesting multisensory rooms in which any user can create and perform both graphics and music by manipulating simulation parameters and by manipulating a number of interactive playware modules (e.g. tiles or cubes). The multisensory room is a cross-media platform, which points towards cross-modal and cross-sensory artistic results. As indicated by Pagliarini and Lund [14], the playful creative multisensory room combines different input and output methodologies, systems and tools that might lead to a broader vision of software and robotic systems with an articulated, fluid and bidirectional flow between the physical and virtual environment. It is believed that such a fluid and multifaceted representation of a single activity may widely enhance the user immersion into a reality that combines multi-sensory activation (physical/virtual).

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Authors Introduction

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Professor, Ph.D. Henrik Hautop Lund, Center for Playware, Technical University of Denmark, is World Champion in RoboCup Humanoids Freestyle 2002, and has more than 200 scientific publications and 5000 citations. He was awarded the Most Outstanding Healthcare Innovator in the World in 2019. Over the last year, he received international awards in Tokyo, Singapore, and London. He has developed shape-shifting modular robots, presented to the emperor of Japan, and has collaborated closely on robotics and AI with companies like LEGO, Kompan, BandaiNamco, Microsoft, Mizuno. He is the inventor of the Moto Tiles (www.moto-tiles.com), which are used by seniors all around the world.

Luigi Pagliarini

Luigi Pagliarini is an artist, psychologist, software designer, expert in robotics, AI and Artificial Life. He is currently Professor at the Academy of Fine Arts of Macerata (Italy) and Consultant Professor at DTU Center for Playware (Denmark). He has published in different international books, journals, congresses and conferences proceedings and has been rewarded with international prizes more than once. He has exhibited his work in different museums and institutions all over the world. Luigi Pagliarini has also worked for many different institutes and universities as professor or researcher and, as consultant, with many enterprises and multinational factories. His work has often been reported on many international newspapers, magazines and televisions.