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Playware ABC: Engineering Play for Everybody

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Abstract

This paper describes the Playware ABC concept, and how it allows anybody, anywhere, anytime to be building bodies and brains, which facilitates users to construct, combine and create. The Playware ABC concept focuses engineering and IT system development on creating solutions that are usable by all kinds of users and contexts. The result becomes solutions, often based on modular technologies that are highly flexible and adaptable to different contexts, users, and applications.

Keywords: Playware, user-friendly, modular robots, playful robotics and intelligent systems.

1. Introduction

Play is a free and voluntary activity that we do for no other purpose than play itself. When we play, we experience a joyful feeling and being free to express ourselves. There is no product or end-goal with play, but it holds a life-fulfilling sensation of freedom and expression of yourself when in play. As is described in the UN Convention on the Rights of the Child, article 31 [1], every child has the right to play and leisure. Even, there exists organisations such as UNICEF, Right To Play and Playright Children's Play Association, which worldwide promote children's right to play. For instance, Right To Play work with the idea that "play is a powerful tool to change the world. It can inspire individuals and bring together entire communities. A game of football can educate children about tolerance and peace, and a game of tag can teach about malaria. When children play, they develop skills like cooperation, confidence and leadership–all important life lessons. Play provides a retreat from everyday hardships and brings joy and laughter, allowing kids to be kids." [2]

Play is for everyone, as described in work on play for the elderly [3]. Though society has often viewed play as a childish and frivolous activity, we all engage in play over our entire lifespan, and engage in such play activities in which we forget about time and place just for the enjoyment and pleasure of play itself. Games, sport, art, sex, and scientific research activities can in many cases be described as playful activities in which the subject performs an ontological shift forgetting about time and place, and in which the activity has its own course and meaning. The play activity provides life fulfilling enjoyment and meaning to the player. The player can be of all ages. It appears limiting and exclusive to define such life fulfilling enjoyment as an activity for children and youth alone. Play is, for everybody, a fundamental activity submitted to free will. In the act of playing, we manage our lives at our own choice, as we create the special form of lived life outside the "regular" life where (lust for) life and happiness as the essence of play rules. When we play we become, in the words of the philosopher Friedrich Schiller, "a whole and complete human being" [4].

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Further, scientific studies [3, 5] have shown the collateral effect of play. 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 [5].

If we agree that everybody has the right to play, we also have the responsibility to ensure that we facilitate such play for everyone in the development of our society. It seems valid to ask if play happens only when you have the economical freedom to play and time to spend on play? If that is so (even if it is only so to some degree), then such wealth requirements may limit the possibilities of play, including the derived creative possibilities, for part of the global population. Further, since the development of modern technology to a large degree is a development, which defines our global society, we need to ask if the technology development allow everybody to participate, or does the technology development actually provide a further division in our global society between the technology savvy who have been brought up with technology as part of their daily life, and the non-tech population who have not had such a tech-filled upbringing? With the penetration of technology into all kinds of aspects of our lives and society (including play), there is a risk that opportunities are further polarized between the experts and non-experts of such technology, unless technology developers are consciously taking the task upon themselves of making technology, which can be easily implemented, understood and used in all kinds of contexts globally.

Therefore, in this work, we outline a concept for how it is possible to develop playful technology, which can be used creatively by anybody, anywhere, anytime. By concrete examples, we will describe the collateral effects of play with such playful technology.

2. Playware ABC

Playware is defined as intelligent hardware and software, which creates play and playful experiences for users of all ages [6, 7]. Often, it is believed that such playware can mediate other actions, for instance actions such as social interaction and physical movement. It has been outlined how the playware may act as a play force that pushes the user into play dynamics [3]. The playware is a mediator, which acts like a play force. The user is drawn into making interaction with the (playware) technology, and by acting as a play force, the playware pushes the user into a play dynamics. When you are in such play dynamics, you may feel transformed from the normal state of being and feel as if forgetting about time and place. Sometimes we may feel being able to perform more or better when in play, which is interesting if such performance may have a desired collateral effect. Indeed, Vygotsky puts it like "Play creates a zone of proximal development in the child. In play, the child always behaves beyond his average age, above his daily behavior; in play it is as though he were a head taller than himself. As in the focus of a magnifying glass, play contains all developmental tendencies in a condensed form and is itself a major source of development." [8].

We believe that this quality of play may translate to many different groups of people. The vision of providing this quality of play and its collateral effects on many different groups of people imposes a design challenge on the playware to facilitate interaction by anybody. The *Playware ABC* concept addresses this issue. The Playware ABC concept if 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.

Often, engineering and IT system design takes it's starting point from solving a given challenge with any technology solution available in order to achieve optimal performance under a given circumstance. This often results in systems with high performance, but with a complex installation process, which demands a large infrastructure. The Playware ABC concept suggest 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*. A demand for anybody, anywhere, anytime on the technology design should be the starting point, which forces us to find flexible solutions that can be used easily and in a flexible manner in all kinds of contexts. Fortunately, high performance and robustness of the engineered IT solution also derives from this focus on anybody, anywhere, anytime, since such performance and robustness is critically important to allow anybody to understand interacting with the solution, and to apply it anywhere.

A solution for allowing anybody, anywhere, anytime to understand and interact with the technology may be to use a modular approach derived from modern artificial intelligence, namely from embodied artificial intelligence [9]. In embodied artificial intelligence, focus is on understanding intelligence by building complete agents (robotic systems) interacting in the real environment. As opposed to good old-fashioned artificial intelligence, which to a large degree imposed a division between the body (hardware) and the brain (AI software) for instance with symbol-processing systems and expert systems, embodied artificial intelligence states that there is an intimate relationship between the body and the brain. A modular system of physical modules with processing power allows us to be *building bodies and brains* [10]. As the physical structure (body) is being built, the processing structure (brain) is made with those same building actions.

By using this concept of building bodies and brains, the abstract cognitive challenge of programming is transformed for the user to become physical actions of building. Essentially, the representation for a cognitive challenging problem is transformed to a physical representation. In a sense, this is similar to instructing small children to count numbers and make addition with their fingers: instead of using the cognitive challenging abstract representation of the numbers and addition operator, they are instructed to make a physical representation, which transforms the cognitive challenge. In this manner, engineering systems of modules may allow anybody to construct technology solutions by building bodies and brains.

By designing, engineering and testing the modules in the right manner, so that they facilitate that anybody, anywhere, anytime can be building bodies and brains, we facilitate that these users can essentially *construct, combine, and create*. The users will construct and de-construct with the modules by making different combinations and physical structures with the modules (which results in different bodies and brains). By constructing and combining with the modules, the users create their different solutions. Different modules combinations will give different results in terms of physical layout and processing result.

By playing with modules, the users should easily understand the content and the construction possibilities. Therefore, the engineering design must ensure a seamless interaction and understanding for anybody. This demands focusing on such seamless interaction and understanding for anybody in the engineering design of the modules, their content, their affordance and transparency, etc. The Playware ABC offers this focus in the engineering design process.

3. Playware ABC implementation

Utilising the Playware ABC concept, we can design modules that allow anybody, anywhere, anytime to be building bodies and brains, which facilitate that anybody can construct, combine, and create. The form, content, and interaction modalities will be defined by the application area, and will vary dependent on this, as exemplified in Fig. 1. Fig. 1 shows examples of modular playware systems, which we designed according to the Playware ABC. They include (a) ATRON self-reconfigurable modular robot, (b) I-Blocks in LEGO Duplo e.g. used in primary schools in Tanzania, (c) Light&Sound Cylinders and Rolling Pins for elderly dementia patient therapy in multi-sensory room, (d) modular interactive tiles for rehabilitation of stroke and cardiac patients, (e) modular interactive tiles for rehabilitation of mentally and physically handicapped children in Africa, (f) Fable user-configurable modular robot, (g) Fatherboard modular robotic wearable, (h) modular interactive tiles for soccer and playgrounds, (i)

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Music I-Blocks, (j) MusicTiles magic matchboxes, (k) MusicTiles magic cubes for the Roskilde Festival.

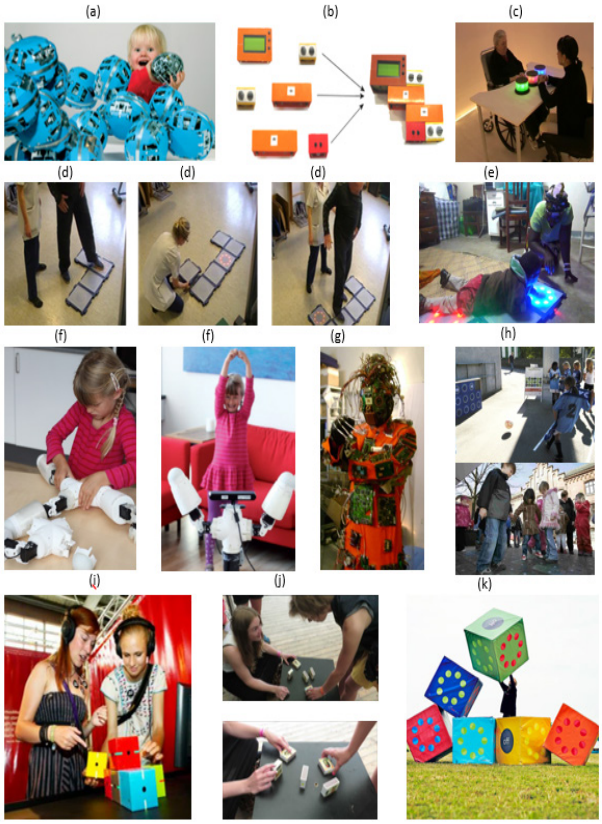

Fig 1. Examples of modular playware systems with user interaction: (a) ATRON self-reconfigurable modular robot, (b) I-Blocks in LEGO Duplo, (c) Light&Sound Cylinders and Rolling Pins for elderly dementia patient therapy in multi-sensory room, (d) modular interactive tiles for rehabilitation of stroke and cardiac patients, (e) modular interactive tiles for rehabilitation of mentally and physically handicapped children in Africa, (f) Fable user-configurable modular robot, (g) Fatherboard modular robotic wearable, (h) modular interactive tiles for soccer and playgrounds, (i) Music I-Blocks, (j) MusicTiles magic matchboxes, (k) MusicTiles magic cubes.

In the shown examples, the modules were designed based on the Playware ABC concept, so there is no need for any complex infrastructure or installation. Instead, the modules can easily be used anywhere on any continent of the world within minutes. Users ranging from small children with mental retardation in Africa, over professional football players in Europe, to older dementia patients in Asia can use the technology immediately.

4. Discussion and Conclusion

We developed the Playware ABC concept to focus engineering and IT system development on creating solutions that are usable by all kinds of users and contexts in our globalized society. The Playware ABC should result in systems that allow anybody, anywhere, anytime to be building bodies and brains, which facilitates users to construct, combine and create. The concept was exemplified with numerous examples of systems based on the Playware ABC concept, which allow use by mentally disabled children, users in developing countries, elderly stroke patients and dementia patients, etc., along with professional musicians, footballers, etc. In future, we will investigate further the adaptation, contextualisation and implementation of such Playware ABC derived technology solutions in different contexts.

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