Tiler. A physical to virtual control system implementing an art-based game

Luigi Pagliarini[1,2], Henrik Hautop Lund[1]

[1] Centre for Playware, Technical University of Denmark, 2800 Kgs. Lyngby, Denmark
[2] Academy of Fine Arts of Macerata, P.za Vittorio Veneto 5 - 405150, Macerata, Italy

l.pagliarini@abamc.it

Abstract

We hereby present Tiler, an art-based game where a virtual world made of tiles and controlled through a set of electronic cubes where players can/should gather the decoration of a floor based on aesthetical criteria. Such a tool allows projecting and designing bi-dimensional shapes by physically manipulating tri-dimensional objects. Besides that, Tiler, is an application that brings to life a clear example on how we can achieve new ways of interfacing the physical world with virtual ones. In the following article we introduce the logical and technical aspects of this real-to-virtual interface and show its potential applications in different fields.

Keywords: Interactive Art, Multisensory Rooms, Playware, Games.

1. Introduction

In this paper we report about *Tiler,* a research prototype for a Virtual-To-Real tool that, implementing the knowledge described in Pagliarini's Code [1], allows users to get engaged in a sort of art-based game and allows them by manipulating with their own hands a set of electronic cubes so to obtain aesthetical results either under the visual art and musical point of view. Strong of our long-lasting experience on such modular and interactive electronics artifacts as Moto Tiles [2] and Music Cubes [3], as well as interactive art [4] and gaming [5], we began to develop Tiler, a complex but easy to use device, by which participants might evolve dynamic geometry and might insert sound effects within it.

Basically, thought to be used in multisensory rooms, the whole project is meant to provide a dynamic, interactive and smart manipulation of physical object in order to obtain personalized aesthetical results while consciously gaming, and unconsciously eliciting and pushing on different cognitive skills, such as attention, stimuli responsiveness, memory, etc. Therefore, the Tiler project, itself, might be reviewed and reported under different angles and perspectives, since it can be considered either entertainment or therapy or, under a scientific point of view, a step forward in the research world of human oriented interfaces.

The choice of using an art-oriented output was taken to enlarge the range of the target of users as much as possible, so to be inclusive in respect of all the possible ages and gender and, possibly, generate a cross generational interaction media.

Despite of the fact that, at the very moment, the Tiler algorithm and related electronics are both prototypical (i.e. many possible variables as interface size, gaming speed, etc. are still to be properly tested), we are engineering the gaming experience so that it should be noise and errors resistant. We are also working at comprehensibility since we believe that it should be quick to learn. In the same fashion usability, that should be as easy as possible. Even the flow of the interaction has been conceived so to reduce the amount of eventual frustration at the minimal terms, so that game-dynamic returns in any case a certain degree of satisfaction uncaringly of the users' response and the final output outcome.

There is not a single specific goal in the game and the aim, which is assembling the floor of tiles that appears on the tablet and can be projected on to the screen, is surely aesthetics of shape and sound. Nevertheless, since there are several options that can be manipulated (e.g. speed, shapes, colors, etc.) to achieve an evidently good result might be either tricky or conditionate by cleverness, and psychological factors as well as physical ones. Certainly, individual view and taste for aesthetics will also direct the interaction with the game.

2. Technical Implementation

The basic game set consists in a group of physical electronic cubes, whose number can be customizable and depends on the number of variables introduced in the game itself. Roughly, each cube (Fig. 1) is provided with an inner electronical circuit with a microprocessor that controls an accelerometer and Bluetooth system, which is able to send information about cube rotation to the Android or iOS App that controls the game either on tablet or smartphones.

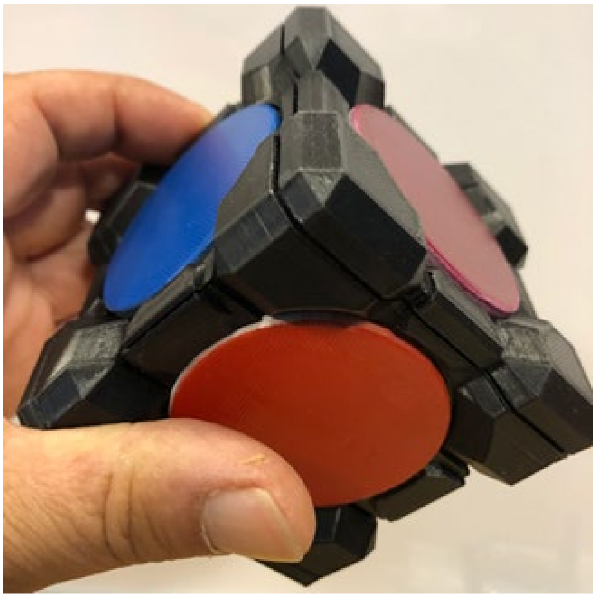

Figure 1. One cube example.

Each cube represents a specific variable and on each side of a specific cube, alias variable, the virtual representation of a possible value of the variable itself is coded. Therefore, tilting an active cube results in changing the denotation of a value in the system and as a consequence it will modify the state of tile in the virtual system.

The different cubes embody the variables introduced in the virtual system – at the moment they are Color, Shapes, Orientation, Sound, Speed, Direction, etc. – and, of course, they can be in a potentially quite large number whose only limit derives from the potentialities of the Bluetooth communication capabilities.

When starting a game session, users have to go through a quick initialization process that allows the app pairing the different cubes with the itself and recognize how many active cubes there are and which variables might be manipulated. The Tiler's App also forsees the not obvious capability of dynamically reallocating the number of cubes to use at each and every moment, so allowing the user to change the dynamic of the game instantly and constantly.

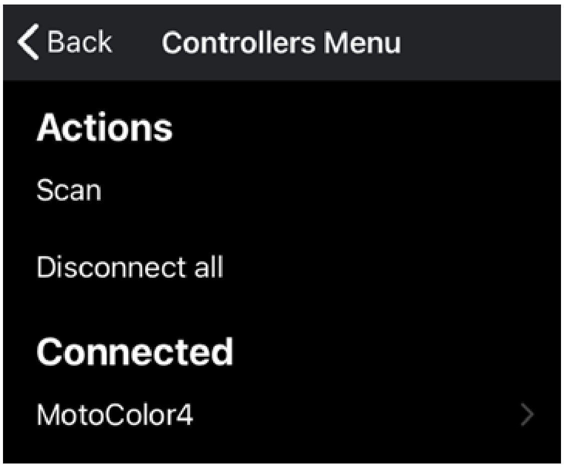

Figure 2. Pairing cubes in Tiler App.

The other side of the game consists of an application for mobile devices, which embody explicit techniques that allow to mutate a 3D based logic, consequent of the cube manipulation, to a 2D one, subsequent of the virtual tiles' management. Under many aspects, this was the most innovative and challenging task we did encounter and solve. Indeed, as even envisioned in many sci-fiction movies, one of the most promising evolutions of computer science is about interfacing 3D object manipulation in the physical world in order to obtain a 2D virtual representation of humans' actions.

To bend the binary logic imposed by screens and other informatic tools within a three-dimensional world we had to proceed carefully and, step-by-step, defining a correspondent meaning, variable by variable, while keeping and an eye on the whole, so that the integrity of the process could be coherent.

Therefore, each single cube needs (and has) its own symbolic representation that recalls the variable is calling and within it has a set of variation that allows to represent six (i.e. the sides of a cube) states that interfere with the output in a fulfilling or satisfying way. In the above figure (Fig. 1) it is shown the cube that allow to change the output colors, which is an easy task, which is made transparent to the user by the color coding with color patches on the sides of the cube. In other cases, such as orientation, speed, direction and mainly shape it might result more difficult.

Figure 3. Tiler App appearance.

The basic configuration of our output set was that of a chessboard in which the user can manipulate each single square while the flow of the focus on the single squares is by default automatized or can be manipulated by the user itself by tilting a specific cube. The square under manipulation is constantly highlighted (see Figure 3). In the above Figure 3 the Tiler App is using the famous Truchet tiles [1] schemata (see Figure 4) with the addition of two states (i.e. full foreground and full background) so to adapt it to a cubic logic. Hence, the color, shape or rotation underneath the cursor will change based on a rotation of the related physical cube.

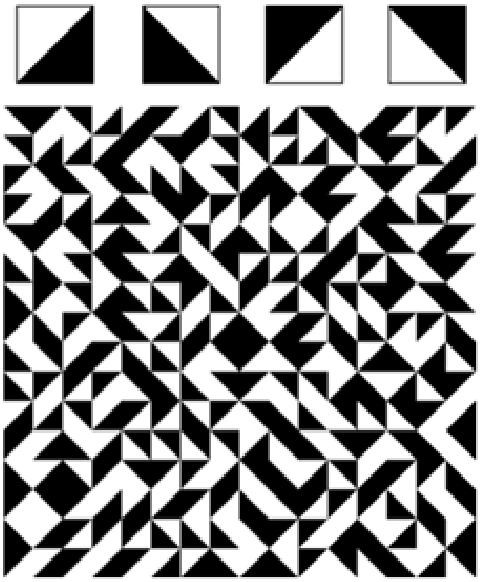

Figure 4. Truchet tiles schemata.

3. Discussion and Conclusion

The prototypical implementation of Tiler presented here has focused on the visual art, and how to allow the user to become creative with the visual art. It is currently implemented to run on an Android or iOS smart device, e.g. a tablet. This facilitates that the system can easily be set up anywhere as a component of a multisensory room. For the Tiler visual art part, this can easily be achieved by projecting the tablet visual representation onto a wall in the room, see Figure 5.

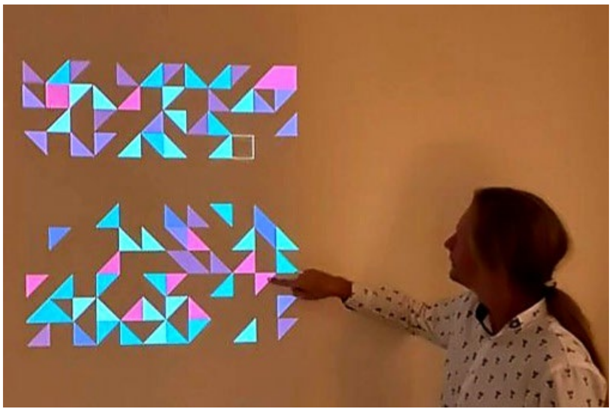

Figure 5. Tiler projected onto the wall as part of a multisensory room.

This may allow us to easily use Tiler as one component in multisensory rooms based on modular playware, in which modules with different sensorial modalities can easily be added and removed to create flexible multisensory environments (see example Fig. 6).

Figure 6. A playful creative multisensory room in the HC Andersen children's hospital in Denmark, in which the patient and the parent are using a modular playware cube to play with the visual patterns of the wall-mounted Moto Tiles [6].

Indeed, 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 [7,8] and the Playware ABC [9]. 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 work on Tiler is seen as a component for this.

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, and this gave direction to the design and development of Tiler.

Acknowledgements

Authors wish to thank Massimiliano Leggieri and Marin Holi from the Technical University of Denmark for their precious work and collaboration.

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Authors Introduction

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.

Henrik Hautop Lund

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.