Orkhēstra - On the design of interactive media architecture for public environments

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Abstract
We present Orkhēstra, an interdisciplinary project set out as a collaboration between architects, computer scientists, media façade designers and an LED manufacturer to find novel ways of seamlessly integrating architectural forms and digital media. Our research interest is based on the circumstance that architects and designers might not always be able to prototype even early instantiations of interactive media architecture in a timely way, and explore the design opportunities that these systems provide, because till today methods and tools in this domain are hardly available and they still demand very high technical expertise. To address these issues we created this installation using custom made prototyping tools that help to co-design and pre-test interactive media façade installations in conjunction with potential users in their environment.

Author Keywords
Media Architecture, Design Process, Prototyping.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Figure 1: Pre-testing animated content for media architecture on a small scale (top) and explorations into suitable interaction concepts (bottom).

Introduction

Media architecture [2] has become an ubiquitous sight across our cities. This umbrella term describes installations that range from urban screens or billboard displays to light emitting elements embedded in the outer shell of a building, or even large projections onto buildings. Architects also began recently to explore digital media as an *additional material* apart from wood, concrete, glass, bricks or steel to build urban structures [4]. This circumstance raises the question how to integrate this *material* seamlessly into our future urban surroundings in an aesthetic and meaningful way. A matter that demands careful considerations such as aligning the various stakeholders, for example, city planners, architects, manufactures and citizens. We argue that successful media architectural interventions in the public environment can be archived through a co-design process that is coined by urban prototyping [3,5]. In our research we acknowledge that there is currently very little guidance and reference literature at hand when crafting such systems from scratch. An issue that prevents also smaller architectural practices from participating in this domain. That is, building even early prototypes of such urban interventions is challenging as it demands a high technical expertise. A skill-set that is mostly also not a standard possession by architects. To address this shortcoming we share our approach using software tools designing Orkhēstra, an interactive media architectural installation created with the aid of purpose build prototyping means and describe a development process that is fun, fast and foundational for tomorrows urban landscape. We consider our video presentation [1] as a way of expressing materially and interaction concepts for media architecture *true to scale* and situated in an urban environment to reveal insights on the suitability of a chosen interaction concept and reflections on aesthetics.

Related Work

The development of interactive media architecture has been presented by Haeusler et al. [2]. Daalsgaad et al. identified eight key challenges in the design process [1]. One of them, "developing content to suit the medium" has been addressed by Hoggenmueller and Wiethoff with custom made prototyping tools to built early versions of concepts and conduct pre-tests with interactivity [3]. An approach that was further utilized and developed in the design process of this installation.

Designing Orkhēstra

We built this installation in conjunction with a group of architects and a large light emitting diode (LED) media façade manufacturer. While the goal of the architects was the exploration of self-supporting, laser cut materials our focus was on the seamless integration of digital media using off-the-shelf hardware components. As the development of content to suit the medium has proven challenging [1] we relied on small scale pre-testing and software tools (see Figure 1) in the initial phases of the project.

Hardware

The utilized LED modules for the final setup were manufactured by the company AHL[2]. In the installation we utilized a total of 4650 *pixels* (3 x high power, 12V / 0.72W RGB LEDs per *pixel*). A single LED pixel works with 8 bit per color channel, resulting in a total of

[1] http://vimeo.com/95281731

[2] http://www.ledahl.net/

Figure 2: Pre-testing animated content for media architecture on a small scale (top) and explorations into suitable interaction concepts (bottom).

potentially 16.7 million different colors. For addressing the LED modules we have used two AHL CP950 controllers. The controllers can be connected to a computer via a CAT5 cable. To power the LEDs we have used 17 power supplies (350 watt per supply).

Interactivity

For the explored interaction concept we envisioned a mechanism that would not require signage or instructions on what to do, we rather selected a method that would allow the visitors to discover interactivity by themselves: At the venue where the installation was exhibited, the Luminale[3] a bi-annual light festival across the city of Frankfurt in Germany, we envisioned that many passerby would take photos of the exhibited sculptures. We therefore created an interaction mechanism that would detect photo flashes and react to that: once a photo of the installation was taken it *reacted* with a dynamic animation where „color/light tubes" were *flowing* over the sculpture. The utilized hardware for this part consisted of a MacMini[4] an Arduino Uno[5] and six dismantled Nintendo Wii-Remote-IR-Sensors[6].

Software tool

As the design of the LED *mapping* and the content of the embedded LEDs of this installation was challenging (i.e. which pixel does what and where) we have implemented a purpose build application which can assist architects with no coding experiences to develop their own content by themselves. The application was implemented in Java - for development we have utilized the Eclipse IDE where we embedded Processing's core library. The lighting animations were implemented with Processing[7]. The application is operated via a custom made graphical user interface (GUI) which has the ability to generate a live preview of the animations (see Figure 2, bottom). We have made this application freely available[8] and provide the opportunity to customize our software to suit also other contexts and situations as the one described.

The implemented application works as follows: If, on a hardware level, individual LEDs are bundled, in our case we referred to these LED clusters as *nozzles* (= one basic element of the sculpture) then the GUI screen setup has to be adjusted to the physical characteristics of the installation (see Figure 2, bottom). In our setup each *nozzle* was equipped with 45, 60, 75 or 90 bundled LEDs forming a circular, low-res *screen.* In total the whole installation consisted of 66 *screens* with a possible max. resolution of 12x5 pixels per *screen.* Because of the low-resolution and non-planar pixel-layout in our installation, the lighting animations were reduced to minimalistic animations and resulted in a cyan glow-effect (see Figure 2, top) which was overlaid with a *sparkling* white animations when a camera flash was detected anywhere on the outer shell of the sculpture.

[3] http://luminapolis.com/

[4] www.apple.com/mac-mini/

[5] arduino.cc

[6] www.nintendo.com/wiiu/accessories/

[7] processing.org

[8] https://github.com/HoggenMari/

The *sparkling* animation then began lighting up rapidly at a random nozzle and ended also at a random nozzle, passing all physical adjacent *screens*. Therefore, all single *screens* were registered in an adjacency matrix to calculate the shortest path for the color tubes and the animations to *flow*.

Discussion and Conclusion

We present the media architectural installation Orkhēstra which was created for a public event in an European city. The installation served as medium to explore the design process in an interdisciplinary collaboration between human-computer interaction (HCI), architecture and industrial partners to create new archetypes of architecture for the urban landscape of tomorrow. We supported this process with a software tool that potentially allows a wider audience to participate in the creation of creative content rather than fighting technical burdens in a field which still demands highly technical skill-sets. Hence, we consider such design process extensions and tools as *enablers* for individuals with a limited financial background to participate in this emerging opportunity field. In the near future we aim at further substantiating this research domain with tools and services for the systematic creation of these systems.

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