My Building is my Display

omnipresent graphical output as hybrid communicators

Odilo Schoch

Swiss Federal Institute of Technology ETH Zurich, Department of Architecture

http://www.caad.arch.ethz.ch, schoch@arch.ethz.ch

This paper presents an innovative approach towards the possibilities and challenges of the built environment as a multidimensional graphical output device. The near future will witness every single part of a building being digitally connected. Consequently, buildings themselves can be novel media for communication especially of graphical content. Buildings and cities will therefore become gigantic 'displays' without frames or the classical fixed proportions 4:3 or 16:9. Architects should be able to deal with this novel 'material', as the appearance of their architecture significantly changes.

Keywords: *pervasive computing; immersive video; interactive architecture; human computer interface.*

Introduction

Questions of a 'soon-to-be' novel type of multidimensional graphical output of complex typology and large dimension are presented. This article does not present technical nor algorithmic solutions, but it illustrates the novel task in examples and architectural principles.

By examining a basic urban setting, one finds aspects of omnipresent displays (Figure 2): (A) streets are possible displays, especially for changing traffic control and for delivering content to be seen from birds-view, though negative elements to be considered are possible disturbance of drivers, dirt and heavy mechanical loads, (B) close distance surfaces can transport detailed information that is only visible to spectators nearby, therefore enabling certain privacy, (C) backlit facades are difficult

Figure 1
Left: Schematic rendering of a fictitious surrounding with omnipresent media surfaces. Right: detail view at a semitransparent "mediafacade" (source: www.mediaarchitecture.org).
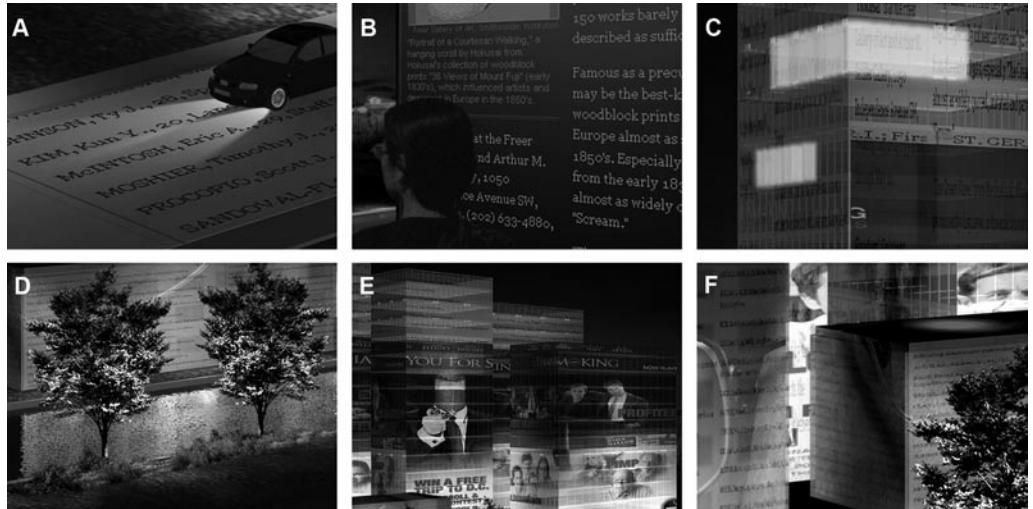
for continuous surface based content, but they offer the possibility to interact with the space behind the facade and the ceilings bottom view, (D) trees and water are difficult objects to use for controlled graphical output, whereas water can be sprinkled and consequently become a good projection surface[1], (E) facades of different buildings can present continuous content but gaps and different reflections cause discontinuity, (F) over-edge-content allows new formal expression of the building.

Examples

A few amazing built examples show a tendency of omnipresent electronic displays. A categorization allows three main movements:

    1. add- on displays

    2.. media facades

    3. buildings designed with media technology as a main element

Add-on displays represent the familiar situation that can be found at urban centers such as Piccadilly Circus, London UK, Times Square, New York City, USA, and The Strip, Las Vegas USA. The buildings are degraded to being brackets for the screens. The screens

themselves attract attention by an increase in brightness and resolution. They are mainly in rectangular form, and would not change the city's appearance much if they were exchanged.

Media facades do take the buildings proportions into consideration. This is seen as a positive step towards 'display-integrated architectural design'. Being a mixture between an enlarged computer monitor and part of the building's facade, the displays as well as the architectural quality of the building may suffer as a result of the flatness and rectangularity of the image. A main example is Shibuya Square, Tokyo Japan. The media facade of the T-Mobile headquarters in Bonn, Germany, shows an additional feature: that screen is partly transparent and allows the combination of effects delivered by the physical conference space behind the facade with content on it. Architecturally more advanced installations are the BIX media facade of the Art Museum in Graz[2], Austria, where the 930 fluorescent lamps are integrated into the buildings' oddly shaped double layer facade. By tuning the brightness of each lamp, changing images and movies can easily be displayed. In this example, the screen is simply wrapped around the freeform build-

1   http://www.swish.ch: June 2006

2   http://bix.at: January 2006

ing. The temporary installation "spots.berlin" by the same architects at the centrally located Potsdamer Platz, Berlin Germany, introduces a monochromatic screen wrapping a curved eleven storey building. The architects aimed for an 'inhomogeneous screen'[3] e.g. made out of different lamp forms and overlaid colored glass. Again, the confinement was towards a low resolution and small colour palette. Earlier examples are the installations of the Chaos-Com-puter-Club in Berlin (House of the Teacher) and Paris (Arcade at the National Library) already introducing user interaction by mobile phone[4].

Nevertheless, the cognitive impact on passing people is strong. A building that is mainly defined by the media facade itself is the Chanel flagship store in Ginza, Tokyo, Japan. Architect Peter Marino used a rectangular screen in portrait format to present monochromatic videos in building scale. The vid-eos being displayed are taking over the proportions of the static physical building itself such as the win-dow-grid and the building size. The videos appear as a fully integrated part of the building. Typologically different is the new Munich soccer stadium "Allianz Arena" in Munich, Germany. Resembling an oversized tyre, therefore a circular, "endless" display. The single textile elements can be illuminated in variations, e.g. as an abstract illustration of the colors of the two soc-cer teams to play the next match in this stadium. Only blurred figurative graphics can be seen at UN-studios

---

³   http://www.spots-berlin.de: January 2006

⁴   http://www.blinkenlights.de: May 2006

facade of the Galleria warehouse in Seoul. The formal appearance of that facade is rather a changing curtain covering the building than a pure display.

When analyzing these examples, a few major findings appear:

a. the more architecturally integrated the screens are, the simpler the technology

b. the more complex the form, the more abstracted the content

c. the larger the display, the more abstracted the content

Current concepts are dealing with interesting hybrid screens that are moving towards a "display integrated architectural design". Germany-based company "ag4" presented a concept for a showroom, where multiple layers of a specific building are used as networked displays. The layers are a transparent media screen in front of a building, the single rooms behind the facade and the objects illuminated with spotlight. Space becomes display.

An example of level of detail is the design by iArt Valentin Spiess, Basel, Switzerland, for a car museum. This design proposes to integrate dozens of mono-chromatic LED text-displays presenting varying texts from an up-close perspective, and a video image from a larger distance. Known applications of small scale dis-plays are e.g. digital doorplates and information panels at train stations and airports. So far they don't integrate levels of details in relation to the spectators distance. The underlying technology of the CAAD from the 1990s might be applied as well as the well known collages of

hundreds single images when smartly combined, giving the impression of a pixilated large image.

At an urban scale the City of Hong Kong, China, permanently installed a coordinated illumination of the city's skyline. It is a highly remarkable effort, given the huge size of the skyline. But its density on possible information transmitters is very low. In June 2006, companies of the city of Frankfurt/Main, Germany, sponsored a temporary light and video-installation called "SkyArena" using their tall office-towers[5]. Projections of subjects related to socker (it's been presented one week before the 2006 FIFA worldcup started) were projected on nearly 10000 m² facade by 40 high end projectors with 60000 ANSI lumen each. Nine buildings were used as screens.

Analyzing the Frankfurt installation: Projections were used instead of self illuminating screens or displays. The buildings were covered with special projection foil – the usual materials used for facades are inappropriate for projects. Mainly rectangular images were projected, responding to the projection technology and not to the buildings proportion. Few scenes delivered continuous content using multiple buildings. Mainly freestanding content was projected – one image on each building, as the perceptibility is distorted by the overall fragmented "urban screen". Formally of interest is that part of the 'urban screen' using an over-edge projection (see building in the centre of right image in Figure 5) allowing a spatial impression and detachment of frame-based content.

Visions, Challenges and Principles

When addressing all surfaces inside and on a building becoming graphical output surfaces, one expects among others the following questions:

i) which data format to use?

ii) what are the design-guidelines for content?

An appropriate data format needs to hold information on multiple view points of the same content, levels of detail and necessary output qualities. Multiple viewpoints can be considered by knowing the built surrounding of the specific building currently acting as

[5]   http://skyarena.hr-online.de: June 2006

a display. The question of 'level of detail' appears when regarding an individuals' position in relation to a surface: the range is from a few centimeters up to many kilometers. Examples for close-up range displays are found in exhibitions where huge LED screens appear to be used as electronic wallpaper. According to their architectural position, the content is adapted: large scale pictures, videos or detailed text messages are displayed. Up close, detailed or abstracted graphics appear.

Challenges are as well legal aspects, such as copyrights, undesired advertisement, privacy and optical dilution causing danger, e.g. the deflection of drive's attention by irritating visuals. Automated filtering might help to partially proof-check the content, but it's high complexity will challenge as well human abilities to control.

The classical architectural topology of buildings define novel questions like spatial movies, that e.g. fill the ceilings of high rising buildings. Figure 6 illus-

trates the different elements that define a real spatial display where the content displayed on all surfaces needs to be coordinated within the media format.

Content

The examples of architecturally integrated displays show two trends: i) the information density that is displayed is roughly constant in relation to the observer's field of vision; ii) the content is more poetic the larger the display.

When considering the idea of omnipresent displays, then old knowledge of painted virtual space has to be studied. Especially during the central European Baroque, painted illusions extended throughout physical space. Panoramic technologies do consider the individual movement of observers. The panorama installation of the 19th Century and the newly appearing digital projections bring telepres-
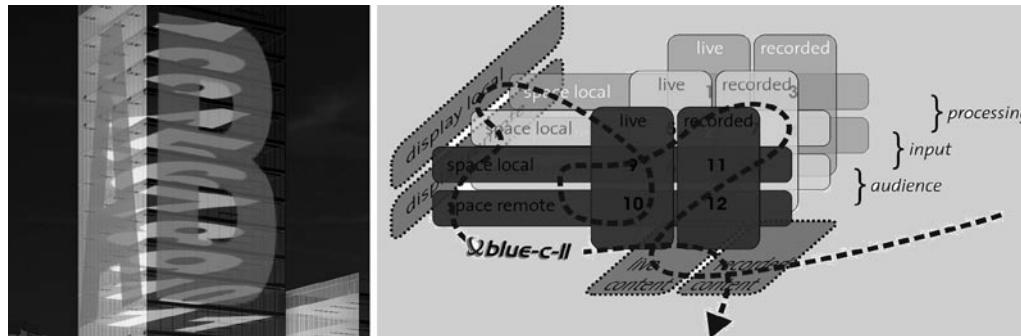

Figure 6
Left: one single building offers multiple surfaces for displaying graphics - in ideal case all content is coordinated in size, content and position by new file formats. A and B are vertical facades. 1 to 11 are the ceilings each floor, visible from street level. Right: space-time-content-matrix of the blue-c-ii project for immersive video displays.

Figure 7
Left: The unexpected illumination effect of the media-screens at the Piccadilly Circus in London. Right: Virtual Window, discussing trusted telepresence. A projection by artist H. Schabus that shows the world directly behind the wall as animated wallpaper, Kunsthaus Bregenz, Austria.

Figure 8
Left: Big poster print in Berlin (image source: morgenpost. berlin1.de); Middle: Baroque architecture as example of mixed reality. In front real performance, background painted scenery (image source: www.hetlbe.nl);Right: Carpet showing stairways as optical illusion, by Tom Frantzen, Amsterdam (imagesource: www.frantzen.nl).

Figure 9
Left: Spatial digital interaction, Sony Playstation's with eye toy during seminar at ETH Zurich; Middle: Mobile phone interactive city game "REXplorer" in Regensburg, Germany (image source: ZDF television); Right: interactive carpet projection by Petra Trefzger.

ence and spatial extension. This may lead towards answers of the above mentioned challenges.

Most of the examples mentioned do present content to passive spectators. Interactivity with the displays, both private and public displays need to be seriously designed. This is relevant to the content being presented. Here again, we see architects as main designer of new services based on multidisciplinary research. This is because of the architect being experienced in spatial thinking and handling multidisciplinary aspects. By this the qualities of a display-integrated architecture can be fully utilized in the content of the images/videos shown. Research done by the Chair of CAAD at ETH Zurich are illustrated in the projects REXplorer (in co-operation with Steffen P. Walz, and the RWTH Aachen (Prof. Jan Borchers and Tico Ballagas[6]), the ImageWall at Zurich's ScienceCity and ETHGame[7].

Optical delusion is a topic to come up with when discussing the possibilities of content in relation to architecture. Figure 8 show an example of a big poster

print in Berlin covering a huge building site. The poster illustrates one of the landmarks (actually physically located 5 kilometers more west). Depending on the viewpoint and perspective (e.g. close, and not seeing the borders of the poster) , large images do change the appearance of the real volume. Dutch Artist Tom Frantzen uses analogue material in order to create an spatial illusion. In conclusion, it looks like the principles of baroque spatial delusion can partly applied. Such as integration of real and virtual space into the graphical content, 'covering' of structural openings.

Technology

This is not a collection of all possible ways to generate graphical output, but an excurse into issues of electro-graphical output in architecture. Main issue of graphical displays based on active light sources is the day-night discrepancy and respectively the sheer power of sunlight. Displays for daylight use are existing, but rarely can compete with sun. Architectural solutions such as roofs and framing boxes are mainly used in order to cast local shadow on the display. In

---

6   http://rex-regensburg.de: June 2006

7   http://www.building-ip.ethz.ch: June 2006

smaller scale, the displays themselves protects the light emitting diodes (LEDs) with a small horizontal cantilevering bar above each pixel, and therefore casting shadow in miniature size.

The potential of displays in urban scale is highlighted by research, observations and trends in the field of architecture. Questions of geometric relevance are schematically highlighted. Possibilities given by current building services technologies will propose solutions that integrate the different life-cycles of a single image of a movie (0,04 sec) and buildings (> 50 years = >1'576'800'000 sec). The paper tries to motivate the computer graphics community to deepen the work in this interesting field.

The principles of building and contemporary building technologies are simple, as buildings may remain for centuries whereas electronic images can vanish after less than a second. In building design, architects distinguish between structural and convertible elements. Examples of structural elements include bearing walls, columns and floor decks. These elements are changed or modified once within 50 years. Facades can be changed easily, which takes place every 15 to 30 years. Electrical installations change roughly every 10 to 20 years in office buildings, and furniture every 2 years. Contemporary electrical installations and digital media are all TCP/IP enabled and thus allow for exchange and interoperability among all devices. Devices such as different buildings, wearable displays and services such as HVAC, sensors, access control, etc.

Classical architectural elements such as space defining elements (ceilings, interior walls, floors, doors, windows, etc.) as well as roofs, streets, etc. already present a high potential for new communicators when they become networked displays. In this, the discipline of computer graphics needs to deal with new issues such as file formats for winding screens, graphics with multiple contents related to the viewers' distance, content and processing. In other words: 'How to bring pictures onto all the surfaces of a whole city, where ceilings of multi-storey buildings, facades and streets are output devices simultaneously watched by some individuals at a 2 meter and others at a 500 meter distance?'

Outlook

Research in spatial video is undertaken in the discipline of "computer graphics". Editors such as the Blue-C-II editor (by M. Waschbuesch, ETH Zurich[8]) offer the real-time editing of video recorded in 3D. Such tool allows the rendering of any arbitrary projection, the positioning of free-curve projection-surfaces and the navigation both in space and time.

Human Computer Interaction (HCI) is the neighboring discipline that allows architects to design systems and content for both small and large public displays. Novel types of interaction can become mandatory as a display in urban scale is different from a personal computer. Mainly because devices such as a mouse are not applicable in outdoor context. Further on, the abilities of displays to handle more than one user challenges the content. As sensors are becoming integrated part of our built environment[9], software enables novel types of feedback in the context of display integrated architecture. In such a case, the system is the manipulator. Applications might be such as active triggering of the urban speed, emergency information, etc.

As concerns the output of 3D-video, Stephen W. Boyer (www.skyboy.com) patented in 2000 a light art structure using LEDs in 3D-grid. James Clar built up a 3D pixel-cube[10] as well as the TU Delft, Netherlands[11].

Conclusion

The architect is about to be challenged by aesthetical, technological and social issues, when designing with media surfaces. Getting back to the baroque may help in order to solve questions of spatial illusion. But it might be necessary to get experienced in designing the nightly appearance of media-enhanced buildings.

---

[8]   http://blue-c-ii.ethz.ch: June 2006

[9]   http://www.sensorspace.net: June 2006

[10]   http://www.james-clar.com

[11]   http://lustrum.etv.tudelft.nl/matrixx/