CITY OF COLLISION: AN INTERACTIVE VIDEO INSTALLATION TO INFORM AND ENGAGE

K. Chorianopoulos[1], T. Rieniets[2]

[1]Bauhaus University of Weimar, Germany, k.chorianopoulos@archit.uni-weimar.de
[2] ETH Zurich, Switzerland, rieniets@nsl.ethz.ch

"It's often the case that artists are ahead of scientists. What scientists do is notice what the artists have done, and then try to understand it."
Donald Norman

Keywords: Interaction design, video installation, engagement, urban conflict, Processing.

Abstract

This article describes an interactive video installation that was developed to inform and engage people about one of the most upsetting geopolitical issues of our time: The Israeli-Palestinian conflict. Several layers of maps information have been employed into a computer application, which was programmed with the open source tool Processing. The video installation was chosen as a medium, to achieve the following aims: 1) The visualization and communication of the Israeli-Palestinian conflict, and 2) the application of ambient intelligence technology into artistic works. In this article, we present the requirements, concepts and design decisions for an interactive video installation that has been tested in the lab. Moreover, we provide a reflection on the creative process and the collaboration between different disciplines, such as architecture, urban planning, cartography, computer engineering and media studies. Finally, we outline the plan to evaluate the performance of the system and the impact of the interactive video installation during an exhibition.

1 Motivation

"The terrible reductive conflicts that herd people under falsely unifying rubrics like 'America,' 'the West,' or 'Islam' and invent collective identities for large numbers of individuals who are actually quite diverse, cannot remain as potent as they are, and must be opposed, their murderous effectiveness vastly reduced in influence and mobilizing power. We still have at our disposal the rational interpretative skills that are the legacy of humanistic education, not as sentimental piety enjoying us to return to traditional values or the classics but as the active practice of worldly secular discourse."
Edward William Said, 2003

Taking the city of Jerusalem as an example –a city of extraordinary historic and religious meaning– the video installation depicts the Israeli-Palestinian struggle for territorial and demographic hegemony, which has transformed the city into a unique urban constellation. The resources and content of the interactive video installation are based on a book published on the same topic and entitled "city of collision: Jerusalem and the Principles of Conflict Urbanism" (Misselwitz and Rieniets 2006).

Almost eight decades of violent urban conflict have transformed Jerusalem into an extreme spatial configuration. From a Western perspective, Jerusalem is all too often considered an uncanny reminder of an age long past: colonial and terrorist violence, which blurs the distinction between the military and the civilian. As a laboratory of conflict urbanism, Jerusalem is in fact closer than we think.

The case of the Israeli-Palestinian conflict, taking place in the city of Jerusalem, is just an extreme example of a problem, which is inherent to urban life in general: The confrontation and negotiation of ethic, religious or political difference in urban space.

Figure 1 A two-page spread from the book "City of Collision–Jerusalem and the Principles of Conflict Urbanism"

The book "City of Collision–Jerusalem and the Principles of Conflict Urbanism" presents a unique collection of essays, maps and photographs, gathered by Israeli, Palestinian and international authors[1]. However, it cannot

[1] Maps for the publication "City of Collision–the Principles of Conflict Urbanism" have been produced during several, trilateral student workshops in Jerusalem. The workshops have been

provide the immediacy and engagement opportunities of a large-scale interactive video system, which is installed in a public space.

The interactivity with the video installation is seen as a complementary to the book, providing entirely new forms of conceptualization, mediation and interaction. In order to realize this project, there was a need for close collaboration between diverse disciplines (McCollough 2004): 1) Urban research to provide appropriate graphic representations of Jerusalem 2) architecture for the physical part of the installation, 3) computer engineering for realizing the dynamic interaction between people and data and most importantly 4) interaction design to translate the static data from the book (image, text, maps) into a elegant and easy-to-use video installation.

In the rest of this article, we discuss the interaction design process and then we briefly present the implementation of the design concepts into a coherent interactive video installation. We conclude with a discussion about the application of ambient intelligence technologies in art and we provide an outline of the ongoing research and evaluation plan for this project.

2 Interaction design

The main design concept involves a double projection of a slideshow on a semi-transparent screen, which integrates the conflicting image that two groups of people hold about the same city.

In addition, we employ real and digital shadows to reveal what is the image of the other side. The role of interactivity is central in the design of the system because it invites people to influence the installation. In terms of interactivity format there are two concepts:

- Interactivity with real shadows.
- Interactivity with digital shadows.

The above initial requirements were mapped into a basic set of concepts that guided the rest of the interaction design. The basic interactivity concepts have many implications for the technical requirements and, at the same time, the interactivity options are defined by what is technically possible. As a matter of fact, alternative scenarios were revealed through the design process, which are discussed next.

Initial requirements and concepts

The basic requirement for the system was to develop an interactive video installation that allows users to navigate the information on the map about Jerusalem.

The initial idea was to mix a set of existing map layers and text from the book according to the position of the viewer. By changing position, some layers would be highlighted, whereas other layers would move to the background. This design concept aimed at a technical and a metaphoric effect: 1) The viewer could change the content of the map by moving in front of the screen. 2) By moving and changing the layers, the viewer would physically and metaphorically changing the image on the city (Lynch 1960).

A direct implication of this early concept was that the input device, which is capturing the position and movement of the users, is placed on the ceiling. An inspection of the installation site and lab experiments with video footage proved that this requirement could not be met easily, because the final site floor was black. Despite the advances in computer vision the majority of the artistic applications have to make some assumptions about the environmental conditions at the site of installation (O'Sullivan 2007).

The conditions at the installation were not suitable and we did not want to employ a white carpet as suggested by colleagues (Weber et al. 2007). Therefore, we had to think of alternative concepts that fulfilled the basic requirement of map navigation in a simple, engaging and intuitive way. Moreover, the design concept should work regardless of environmental conditions.

Although the positioning of the camera on the ceiling would have been a very flexible choice and it provides straightforward two-dimensional navigation, we found that this unforeseen obstacle allowed the effort of the design thinking to be more precisely focused at the core of the requirements for this installation.

Double projection

As long as I have remembered myself, I have moved within two strata of consciousness, wandering in a landscape that, instead of having three spatial dimensions, had six: a three-dimensional Jewish space underlain by an equally three-dimensional Arab space.
Meron Benvenisti

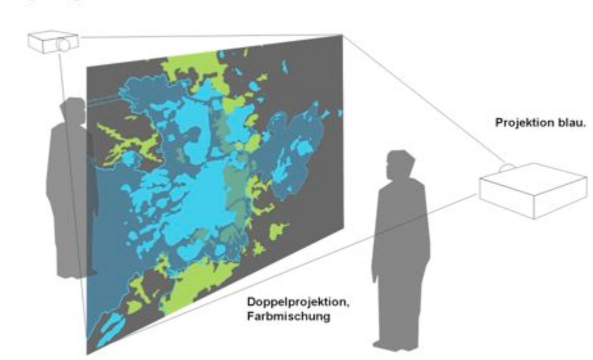

Figure 2 Each of the two sides in the video installation corresponds to the respective (Israeli, Palestinian) image of the city

---

conducted between 2003 and 2005 and were initiated by the research project "Grenzgeografien" (geographies of Conflict).

The basic concept for this video installation originates from the content itself: Two groups – Israelis and Palestinians – are claiming the same space, politically as well as through their different perceptions, narratives and memories.

While two-dimensional printed maps can hardly depict this multilayered urban reality of Jerusalem, a double projection opens up entirely new possibilities: A free standing semi-transparent screen allows for video projections from two sides, each side presenting a particular view on the Jerusalem – an Israeli view coloured in blue, and a Palestinian perspective coloured in green. As the screen consists of semi-transparent material, both projections are mixing on the surface and are unified to one coherent representation of the otherwise divided city of Jerusalem.

Additive colour mix

By projecting from two sides onto the translucent screen, colours are mixing according to the principles of additive colour mixing: The more colours are mixed, the lighter they become (Figure 3). This effect supports the concept of the double-projection of the cartographic essay. If the video installation shows a map of Jerusalem, then the map consists of both views, the Israeli view (blue projection) and the Palestinian view (green projection).

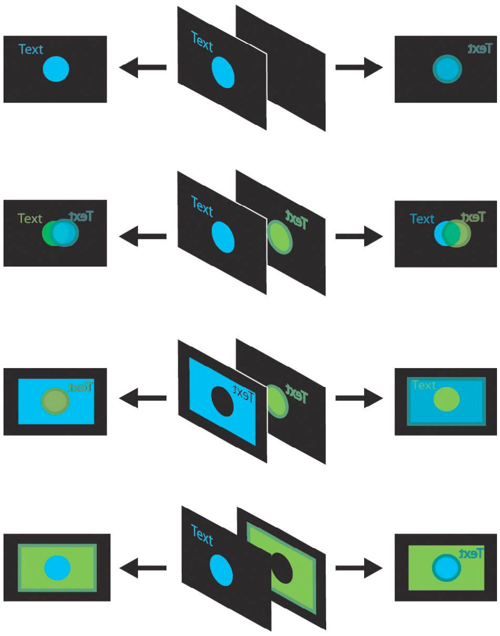

Figure 3 Examples of different types of colour mixing on a double projection system

Shading

Besides the requirement for digital interaction we emphasized a parallel requirement for physical interaction. When the viewer moves in front of the screen there are two effects:

1. When the light from the projector is blocked by the body of a person, there is a 'natural' (real) shadow on the respective side.
2. At the same time digital cameras are capturing the presence of people and perform dynamic effects that combine the 'artificial' (digital) shadow with the slide show.

By shading one projection, the projection of the other side suddenly appears clearly through the semi-transparent fabric of screen. This effect allows for playing with the double projection (front side/back side), and confronts the viewer with his own perception: The more a viewer on one side is taking back his own "view" by shading the projection, the more he can recognize the other side.

Figure 4 In a double screen, if somebody blocks the image of one side, then the image of the other side is revealed

Final requirements and refined concepts

After analysis of the basic concepts and of the aesthetic requirements we devised the following technical requirements for the interactive video installation:

- The interactivity has to be very subtle.
- The system should be technically robust and easy to install and keep running.

In particular, interactivity is realized with physical and artificial (digital) shadows. A 'digital shadow' is an image stored inside a computer, so it could be processed in various ways. For example, a digital shadow could be changed and transformed to create various effects (Levin 2006):

- Shadows can be frozen for some seconds.
- The motion of shadows can be delayed. This effect would enable people to „wipe out" their map.
- Shadows can be outlined or blurred.
- Shadows can be distorted in form
- Shadows can display text or photos

We realized that although a real shadow would have been nice by itself, people might misunderstand the installation and try avoid to make shadows. Moreover we realized that the horizontal motion tracking would be the best option, because:

- It is technically less sophisticated
- The additional material needed is less expensive (no white carpet of fancy hats are required)
- It invites people to directly interact with the screen

The digital shadow however appealing, might evoke same misunderstandings (i.e. 'I am disturbing the projection'). Therefore, we had to devise concepts of inviting and facilitating the involvement of the exhibition attendees. Some of these ideas included:
- Provide an outline of the shadow, so that it looks artificial and is not confused with the real one.
- Use the digital shadow to temporally wipe out parts of the map.
- Pause the slideshow when a person was close to the map.

A technical implication of the latter was that if we employed pausing, the two computers have to be synchronized through networking. Otherwise the whole story-board would be messed up.

In summary, the above refined concepts where mapped into a number of requirements, which bring the interaction design closer to the final architectural and multimedia design. The detailed requirements are analysed in the following sub-sections.

Maps and narrative

The employment of maps into the video installation serves two purposes:
1. The maps are the graphic basis for the double projection. Early exploratory experiments revealed that the more graphic information is projected on the screen, the better the effect of the double projection works (Figure 4).
2. The maps are caring all the information needed to understand Jerusalem and the conflict. However, the maps are rather abstract.

Therefore, it became apparent that maps should be augmented with additional information in order to be legible without the full-text of the book being at hand. Ideally, the maps would become most readable if a narrative is provided. The narrative was envisioned to run as a slideshow that embeds text and symbols that refer to the current map, such as a map legend. Moreover, the slideshow between the two sides should be synchronised, in order to allow for comparison of the two conflicting 'images of the city' through the semi-transparent double projection.

Although the initial installation was planned to take place at an architecture faculty, future instalments could not make such a specific assumption about the scientific background of the users. The information should also assume an audience who can hardly understand the urban scale. Therefore, to give information about the scale, the following information could be added:
- A scale bar (cartographic expression of scale)
- A satellite image (photographic expression of scale)

The slideshow consists of single layers projected one after another. Each layer contained brief text legends (e.g. „Wall; 700 km long; 8 meters high; expropriating 11% of West Bank area").

Outline effect

One concept involved the drawing of an outline around the digital shadow. The outline of the digital shadow serves multiple purposes:

- It might help to make the "holes" (digital and real shadows) in the map more visible.
- If a person moves close to the projector then the outline becomes a metaphorical visualization of the urban causalities like an outline on the asphalt. This concept is based on the idea of the white chalk outline that police paints around a victim in a crime-scene. People could perform in front of the screen in a way that they create similar outlines on the map.
- The outline could have a conflicting colour: On the Israeli side (blue) it could be green, and on the Palestinian side (green) it could be blue.
- The outlines could have the same colour with the respective map so that the map lines mixes with the outlines creates "new maps" of Jerusalem..

Wipe out effect

In addition, to shadows there is a transient wipe out effect. The shadows of the moving people delete the map, but the map rebuilds itself after the person moves out of the camera view. The objective is to create playfulness and involvement with the maps. We decided to call this effect "person as a brush", where the size of the brush depends on the relative position of the person/camera and of the object detection threshold.

Pause effect

It was decided that the slideshow at both sides stops when there is somebody in the view of the camera. If there is nobody in front of the camera there is a delay between each slide. Of course, the software has no idea if someone is in front of the camera. The only thing that the software understands is that something "big enough" to be detected by the object tracking sub-system is covering a "big enough" part of the screen. The former "big enough" depends on the relative position of person/camera and the object detection threshold, while the latter "big enough" depends on the person detection threshold. These options were defined as calibration parameters that depend on the desired qualities and most importantly on the characteristics of the installation location.

One side-effect of the combination of the two requirements for 1) pausing in order to engage passers-by and to motivate exploration, and 2) combined narrative between back and front, which facilitates comparison and reflection, is that the two parts of the projection should be synchronized, in a way that when one of the slideshow pauses (due to a person) the other one pauses too.

3 Architectural and multimedia design

The physical installation of a combined architectural and multimedia system holds many challenges. Each challenge could be broadly categorized in architectural and multimedia categories, or a combination of the two. In particular, we have addressed design problems such as: indoors installation in a public everyday place, double screen projection, narrative with maps, combination of real and digital shadows, calibration of the camera sub-system. In the rest of this section we present the design solutions devised to address the actual installation of the system in physical space.

Figure 5 A model overview of the interactive video installation

Architectural container

The interactive video installation was prepared for an exhibition at the hall of the faculty of architecture at ETH Zurich. The entrance hall is an open public space with high ceiling and at the time of the installation it would host additional exhibitions as well as the normal daily activity of the faculty. Therefore, there was a need to explicitly define a space, which will provide a context and focus for the particular video installation (Figure 5).

Semi-transparent double projection screen

The projection screen consists of a double layer of semi-transparent satin textile. The doubling helps to distinguish front and back-side projection, because through the space between the layers of textile the colours of one side appear bright, while the colours of the other side appear slightly dimmed.

The double projection provides visual comparison of the colliding image of the city between the two groups. After several experiments in the lab with video projectors displaying a simple static image of maps (Figure 4), it was found that a small distance (approximately 8mm) between the textile layers controls this effect (Figure 6).

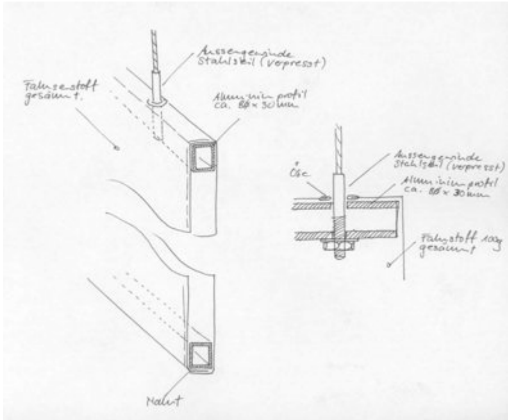

Figure 6 The double projection screen consists of two sides of semi-transparent white textile arranged in parallel to each other and organized in the same frame

The video projectors are positioned at a height of 2,20m. This position allows the viewers to use the installation in two ways: 1) If they look at the screen from a larger distance, they can watch the loops without disturbing it with shadows. 2) If they move closer to the screen, they will create shadows on the screen and can play with the interactivity of the system as described above.

Map layers and narrative

The maps are very abstract and for most people who are not directly involved with the issues in Jerusalem and with cartographic principles difficult to understand. There are several cartographic layers that have been produced for the book and we had to devise a coherent way to manipulate them at the software-level dynamically. We decided that the maps should be presented in a loop. The loop shows one layer after another, providing some additional text- and symbol- based data.

As a result of the double projection, one side will always be mirrored. To avoid an unbalanced representation of the Israeli and Palestinian view of Jerusalem, the projections will change sides after each loop. This effect will be achieved by composing the loops as Möbius strips: The end of the Israeli narrative will smoothly tie in the beginning of the Palestinian narrative, and the other way round.

According to good programming practice, the most obvious way to go forward would have been to load the layers in the software and then manipulate them dynamically and mix them with text according to a given narrative and script notation. At the time of coding the Processing environment was still in beta version and after experimentation with a big set of images (map-layers) it was found that the Processing interpreter was rather inefficient with loading big numbers of images and manipulating them in real-time.

Computer hardware specification

We had to consider the performance of the available computer hardware, which consisted of PowerMacs with dual G4 500MHz processors and 1Gbyte of RAM. In comparison, most contemporary interactive video installations with similar requirements employed one or more dual core computers at 2GHz. Although in terms of software there are many possibilities, which were discussed in the design section, in practice, the performance of the available hardware turns out to be a very important factor in the selection of the concepts that could be feasibly implemented. In total, we employed two separate systems (two computers), one for each side of the projection.

The maps were drawn in Adobe Illustrator and had to be reworked, in order to make them appropriate for video projection. This meant change of colours, line width, sizes of symbols etc. Next, the map layers were imported into Adobe Flash and were edited into a narrative together with the respective text and symbols. Finally, the Flash movie was exported into a sequence of image files, which were loaded in a custom made Processing software and mixed in real-time with the digital shadow.

Digital shadows

The system was implemented in the Processing[2] environment, which employs the java programming language and provides simple interfacing with the functionality commonly needed in video installations, such as video tracking. The computer vision functionality was build upon the BlobDetection Library[3]. The above tools and libraries are open source and run on a variety of platforms that support Java, thus making the application portable. Moreover, further development by the authors or other groups is feasible to be sustained in the future.

The BlobDetection library is based on a threshold between light and dark. Dark and light are measured on relative terms and they depend on the particular installation environment. Also, each camera has different responses. Therefore, there is no recipe for “correct” design of the system besides allowing for calibration of some parameters in the field.

Position of the camera and image transformation

There are more than a few alternatives about 1) the position and 2) the viewing angle of the camera. For example, the camera may be located at 1) top-bottom of the screen or 2) together with the projector. The latter was selected due to simplicity in the installation. In this case, there are some more alternatives in terms of the viewing angle and zoom factor. We decided to have a wide viewing angle, but we are only using (by zoom) the central part of the image, because the rest of the projection contains text.

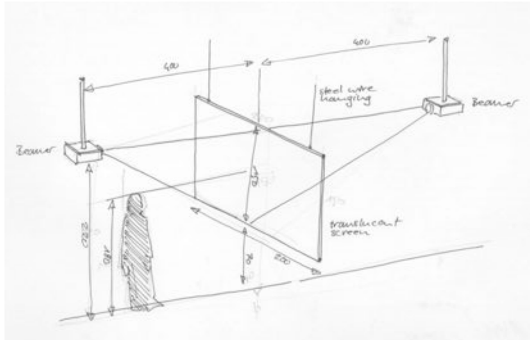

Figure 7 Overview perspective plan with scale and dimensions of the elements in the video installation

Real shadow and digital shadow had to be as close to each other as possible. As long as a person does not move, real and digital shadows have to be identical. For this reason, the camera was situated close to the beamer. This is the only way to capture people in a position, which is identical with the shadow produced by the beamer. If the camera would be at the screen, pointing to the beamer, the digital shadow would be completely different from the real shadow.

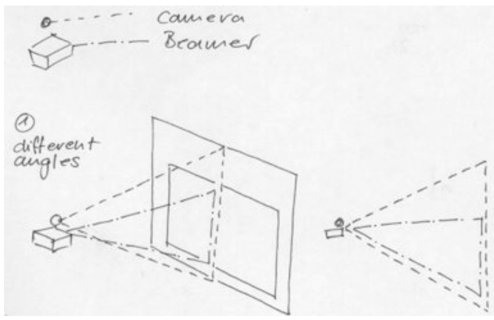

Figure 8 Camera and projector are positioned together

Moreover, there are several advantages of overlaying real and digital shadows:
1) Interactivity will work intuitively.
2) If the digital shadows are inaccurate (because of light cloth or other conditions), it will never have a disturbing effect. Even if there is no digital shadow, the real shadow will remain.
3) The installation will be easy: The camera can simply be attached to the beamer (Figure 8).

If there is one single best solution this would be the use of multiple cameras (Sparacino 2002). In this work, there are already at least two systems into play, so we did not want to add more dimensions to input.

Installation and system calibration in the field

Before calibrating the motion tracking software there is a need to ensure the robustness of the integrated software (slideshow and motion tracking). In general, Ambient Intelligence (AmI) systems are assumed to be seamlessly integrated with the environment and to work in a robust way, despite the possibility of arbitrary input streams that could not be modelled and tested in the lab during development time. In contrast, to desktop computer

[2] http://www.processing.org
[3] http://www.v3ga.net/processing/BlobDetection

applications, AmI systems are supposed to run without stop for the duration of the day or even overnight. In this case, the robustness of the system becomes a crucial requirement.

The main software (Processing) was in beta, at the time of writing, so there might be bugs, such as inefficient memory allocation, which would cause application crash after a while, especially if lots of media are loaded and processed in real-time. This type of bugs are as unpredictable as the input coming from a camera installed in the field and, as a matter of fact, only testing in the field could prove the system. Another remedy would be parsing of the open-source Processing code base, but this is not within the skill-set of most artists. In engineering terminology, there is no analytic way to prove that the system works, so the system has to be installed and left running for many hours in order to validate robustness.

The methodology for calibrating and testing the system in the lab involves one computer with the software, a camera, and a beamer/screen. Then we can monitor how the system performs over time. At the same time, portable computer with camera are taken to the field (the actual installation place) in order to test system response against the ambient light and the background.

In summary, the most important contribution of the employment of AmI technology in an artistic project is the interdisciplinary design process that maps the initial requirements to design concepts and finally to a particular architectural and multimedia design, which is feasible to implement. A reflection on the creative process and on the empirical findings of the design and implementation phase follows.

5 Discussion

The combination of new and traditional media art could be regarded by someone as a dilemma, or even as conflict between traditional and digital mediums, but it is not. This video installation employed a 'traditional' double projection semi-transparent screen instead of mixing the two maps in software over an opaque two-sided screen. Moreover, the use of a double screen allows shadows on one side to become windows that overlook over the 'image of the city' at the other side. The shadows might be real ones due to the light source of the projector, or might be digital ones captured by the camera and created at the software level, which allows an infinite number of further manipulations and artistic expressions. In this way, instead of competing, traditional and digital cooperate to produce a result that is more than the sum of the parts.

AmI systems could contribute to the convergence between different art forms and new media. AmI systems are employing multimodal sensors as input devices, instead of assuming keyboard and mouse. In our work, the use of a camera as an input device for a computer system builds on the aim of alternative human-computer interfaces, which do not have high requirements in terms of skills and effort to use. In this way, the interaction between people and art-works becomes more immediate.

In contrast to the narrow interaction modalities of traditional office computers, the interfaces available in intelligent environments provide extended opportunities for seamless integration with cultural and artistic forms. AmI tools include powerful, small and portable computers, projectors, efficient computer vision, and easy-to-use programming environments and they offer novel opportunities for artistic expression. Moreover, The relationship between tools and artists is mutual. As artists employ new tools in new projects, the tool creators get feedback about the new uses and improve their tools. Indeed, the Processing programming environment is supported by a very active design and arts community.

Besides the technological and design process aspects, the most interesting part of this project is without doubt the potential for social impact. Many video art and interactive video installations do not treat political issues. Instead, they favour abstract representations of social issues. The book behind this project contains much more information and visuals than could be feasible displayed in a video installation. Yet, a book offers only restricted possibilities for engaging and creating initial awareness about the impact of political issues. In this way, the video installation allows for entirely new opportunities and becomes a portal to an important social issue that affects the lives of thousands everyday.

The motivation behind the basic concept was that the installation is a metaphor for the situation in Jerusalem: two groups (Israelis and Palestinians) are claiming the same urban space and fighting for territorial dominance. And both groups have a completely different view on the same city (Lynch 1960). The image of the city has been changing very rapidly and depending on political decisions, activism and other events. In this way, the video installation has the role of memory aid and that of a tool for understanding the current situation. In addition, the integration of computing and networking into this project provides the opportunity to display new map layers, photos, text about new events that alter the image of the city in Jerusalem. Thus, the video installation, besides the artistic qualities of abstracting a geopolitical conflict, it provides further opportunities as a live art-work.

The collaboration between different disciplines was very beneficial both for the creators and for the artwork itself. Actually, it would have been impossible to reach the same status and features in the realization of this project without the many roles assumed at the different phases. For example, cartographic skills were necessary to create and then to transform the vectors maps into combined a slideshow narrative. Architectural design and engineering was employed to design and implement the physical aspects of the installation. Computer engineering was employed to develop a combined hardware and software system that brings together the maps and the presence of people in the exhibition. Finally, all together were orchestrated by considering the interaction design aspects of the video installation. In the next section, we summarize the main outcomes, draw conclusions, and provide an outline of how we plan to evaluate the impact of the system in the field.

4 Conclusions and ongoing work

Three basic concepts have been crucial for this interactive video installation.

1. **Semi-transparent double projection screen** allowing for a direct aesthetic experience of back-side and front-side.
2. **Maps narrative** providing specific information about an urban space. The map layers and the information about them appears in synchronized back-and-front (two parties in conflict) story line, which loops.
3. **Interactivity** inviting the viewer to be „self responsible" for his view on the city. The presence is sensed by means of a shadow (real or digital), which distorts the map and the flow of the slideshow.

The first version of the software part of the system has been developed and tested in the lab. Then the system was installed and tested at the exhibition site in conditions that correspond to the final installation at least in terms of scale and lighting conditions. The first public presentation of the complete installation was performed at the main hall of the department of Architecture at ETH Zurich in Switzerland (Figure 9).

Figure 9 Installation site faces the entrance at the faculty of architecture (ETH Zurich)

The public installation of the system is seen as an opportunity to evaluate the system in a realistic environment and collect feedback about engineering and design aspects that could inform further installations about Jerusalem or other cities. In addition, we would like to test alternative design features of the system. Do people actually like the interactive options at all or do they prefer a simple slide transition? What is the difference in average attendance between the interactive and the simple version? Which kind of visual interactivity is most appealing?

In order to address the above research questions we have implemented some simple counters and image logging inside the motion tracking system and we plan to perform observation and note taking during the exhibition.

In terms of additional software features, we plan to integrate real-time photos and text from web sources. In particular, we plan to employ geo-tagging of external data into the system map. Thus, we would like to enrich the linear and fixed map narrative of the video installation with live information from the field. In this way, there will be many evolving stories told at once and users will be able to compare the multiple overlaying images of the city, which are updated in real time.

We plan to evaluate the application of this interactive video installation for cities that face similar problems of urban conflict, such as Nicosia (Cyprus). Furthermore, it is expected that there are additional case studies for this system, because in most big urban places, even the most peaceful ones, there are conflicts and colliding views about the image of the city.

Acknowledgements

The work of Konstantinos Chorianopoulos is supported by the MEDIACITY project (http://www.mediacity-project.org), which is sponsored by the European Commission Marie Curie Host Fellowships for Transfer of Knowledge (MTKD-CT-2004-517121). The work of Tim Rieniets is funded by a grant form the ETH Swiss Federal Institute of Technology in Zurich and the Institute for Urban Design.

References

[1] Levin, G. Computer vision for artists and designers: pedagogic tools and techniques for novice programmers. AI Soc, 20(4):462:482, Sringer, 2006.
[2] Lynch, K. The image of the city. Cambridge: MIT Press, 1960.
[3] McCollough, M. Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing. MIT Press, 2004
[4] Misselwitz, P., Rieniets, T. City of Collision: Jerusalem and the Principles of Conflict Urbanism Birkhäuser 2006.
[5] O'Sullivan, D. Video By The Pixel, http://tinyurl.com/2qa5gt Accessed on March 8, 2007.
[6] Reas, C. and Fry, B. 2006. Processing: programming for the media arts. AI Soc. 20(4) 526-538, Springer, 2006.
[7] Sparacino, F. Narrative Spaces: bridging architecture and entertainment via interactive technology. 6th International Conference on Generative Art, Milan, Italy, 2002
[8] Weber, J., LD. Stephens, A. Baumann, A.Wolter, Project ION, http://mediaarchitecture.de/projekte/ion/ Accessed on March 8, 2007.