Sensing the Historic City

Designs for the In-Visible

Physical / Digital prototype manifesting graffiti writing activities in Central Edinburgh (García, Fernandez, Petrou, ESALA, Architectural Design 3, Unit 3 2015/16)

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Dr Miguel Paredes Maldonado is a Lecturer in Architectural Design at the University of Edinburgh, a chartered architect and a partner in Cuartoymitad Architecture and Landscape (www.cuartoymitad.es), an award-winning research and design studio whose work has been published and exhibited internationally, most notably at the 11th Venice Biennale. Miguel’s writings have been published in multiple refereed journals, and his design work has been disseminated internationally. Recent exhibition venues include the Museum of Contemporary Art in Badajoz, the FreshMadrid exhibition (Madrid, Brussels, Bogotá, Montevideo and Barcelona), the IV Iberoamerican Architecture Biennial, and the Universities of Edinburgh and Newcastle. Recently finished projects include the conversion of a large eighteenth-century fortress in Santoña (Cantabria, Spain) into the Monte Buciero Museum, and the spatial design and ephemeral architecture for the Zinc Shower event in Madrid. Miguel holds a PhD in Architecture from the Universidad Politécnica de Madrid, where he also taught before relocating to Edinburgh in 2013. He has also held teaching posts at IE University in Segovia and Istituto Europeo di Design in Madrid, and was visiting faculty at the Frank Lloyd Wright School of Architecture (USA) and the Technische Universität Graz (Austria). His research interests focus on the intersection of digital design technologies, urban public space and contemporary thought.

2- Period: The course will be taught over two teaching periods: February 28th to March 7th and March 28th to April 12th

3- Teaching style: Lectures and Design Tutorials
4- Teaching language: English

5- Objectives and Learning Outcomes:
Although the appeal of historic cities like Cagliari lies in their diversity and vitality, as city dwellers we often situate ourselves in restricted domains of human and spatial interaction, oblivious to the richness and variety of experiences that the urban landscape affords. This project proposes an approach to the public sphere that emphasises collective interaction while simultaneously revealing and activating latent spatial connections within human and historical contexts at a metropolitan scale. We will deploy multiple responsive architectural devices as a strategy to reorganise, reframe and augment the collective experience of urban space. Our design endeavours will focus on activating the environment that surrounds our interventions: Architecture will become an input/output public mechanism of human interaction. This project intends to foster a dialogue between digital and analogue techniques and sensibilities, and therefore we will develop hybrid digital/analogue physical environments that simultaneously describe, articulate and transform specific urban phenomena within the fabric of the city.

The course is intended as a transversal contribution to the existing teaching programmes (from Architectural design to Restoration), with an emphasis on providing increased exposure to the use of digital technologies in architecture. Main outcomes are a mutual exchange of innovative practices, with particular attention to architectural interventions in the context of historic urban settings.

Further learning outcomes include: an increased awareness of the particular dynamics of public space within the historic urban fabric, an understanding of the basic workflows of digital sensing and parametric design, and the development of a critical position with regards to data-based design practices in the context of the public domain. From a theoretical perspective, this course intends to foreground the critical agency of architecture in both the production and the transformation of urban public space, and also emphasize the non-neutral role of digital technologies in shaping those processes.

5- Prerequisites:
Students are expected to have a good command of architectural drawing, surveying and mapping techniques. This course will put a particular emphasis on the use of digital tools to undertake both architectural analysis and architectural design endeavours. Therefore, students are expected to have a reasonable knowledge of relevant digital design tools, as well as an explicit interest in gaining increased exposure to advanced digital techniques. The main software packages to be used during the course will be Rhinoceros 3D and its plug-in Grasshopper. Some familiarity with Rhinoceros is desirable for students wishing to take this course. Knowledge of Grasshopper is also desirable but not compulsory.

The Arduino prototyping hardware platform originally developed in Torino- will be used to analyse and map the urban fabric of Cagliari (www.arduino.cc). Basic support for using Arduino will be provided, but students must be willing to engage and develop their work using this platform.

A free trial version of Rhinoceros can be downloaded from www.rhino3d.com Grasshopper is free of charge and can be downloaded from www.grasshopper3d.com Both Rhinoceros and Grasshopper are available for Windows PCs and Mac. However, the use of Windows (especially for Grasshopper) is highly preferable. Please bring a laptop and install the software(s) before the course starts.

6- Contents:
The course will be organised around a sequence of three iterative exercises, which will proceed incrementally, layering a series of models, techniques and processes that will eventually be assembled as a design response that will successfully bridge together the scale of the urban domain and the scale of human interaction.

Exercise 1 will require students to develop Arduino-enabled instruments to develop a survey of qualitative and quantitative data concerning hedonist practices in Cagliari's...
historic urban fabric. Exercise 2 will consist on the surveying and subsequent mapping of the data collected during Exercise 1. Exercise 3 will synthesise Exercises 1 and 2. Students will develop public space propositions and urban scenarios that translate previously explored digital processes into physical actions, and refer them to appropriate sites within Cagliari. The focus will be on the functionality and the spatial ambition of these interventions, and their ability to perform as a distributed network of public space activators for the historic city.

7- Teaching Methods:
The course will be structured around a sequence of: a digital survey exercise (1- primarily field work), followed by a digital mapping exercise (2- representing the information acquired during field work) and a design exercise (3- developing a design response to the urban information that students have acquired and represented). Exercises 1 and 2 will be developed simultaneously during the first stages of the course. Students will work in small groups throughout the duration of the course. Groups will be organised according to the number of students. Teaching will be structured around two meeting days per week. Classes will be either tutorial-based (where work produced and presented by students will be discussed with the professor) or lecture-based (based on short lectures that will provide cues and references to complete the required coursework, including the learning of relevant digital skills). Full attendance to tutorials and lectures is expected in order to attain knowledge and skills that are critical to work in this course. Please bear in mind that this course will require you to actively engage (both in groups and individually) with a range of digital prototyping tools and techniques (including but not limited to- Rhinoceros, Arduino, Grasshopper and Processing). Support will be provided via Arduino tutorials, parametric design tutorials, digital surgeries and extensive lists of online resources.

8- Verification of learning:
Course assessment will be based on the submission of a comprehensive compilation of work produced for exercises 1, 2 and 3 (print-outs and digital files) as well as a public presentation of the results. The expectations in terms of design development will be commensurate with team sizes and the expected year levels of individual students.

9- Texts:
Exercises 1 & 2
ARANDA, B., LASCH, C., Tooling (Pamphlet Architecture 27), Princeton Architectural Press, 2005
DORRIAN, M., HAWKER, A., Metis: Urban Cartographies, Black Dog, 2002
LIM, CJ., Devices, Routledge, 2005
MANAUGH, G., Landscape Futures, Actar, 2013
WEINSTOCK, M. (ed.), Architectural Design (AD) System City, July/August 2013, Profile No 224, John Wiley & Sons
Exercise 3
DÍAZ, C., GARCÍA, E., MEREDITH, M., SAMPLE, H., El Croquis 184 (Amid-cero9 and MOS Architects)
ELIASSON, O., Studio Olafur Eliasson, Taschen, 2012

Arduino, Coding, Parametric Design and Fabrication
BRANZI, M. et al., Getting Started with Arduino, Maker Media, 2014
DUNN, N. Digital Fabrication in Architecture, Laurence King, 2012
REAS, C. et al., Getting Started with Processing, Maker Media, 2010
SHIFFMAN, D., Learning Processing, Morgan Kaufmann, 2015
Arduino electronic prototyping system: https://www.arduino.cc/
Introduction to Grasshopper, 13 part series in with David Rutten http://vimeo.com/channels/basicgh

Mapping and visualisation
Amsterdam Realtime. Available at http://realtime.waag.org
144 Hours in Kiev. Available at http://www.the-everyday.net Diller, Scofidio + Renfro, Musings on a Glass Box https://vimeo.com/179910813
Anastasia Karandinos, Christina Achtypi and Stelios Giamarellos, Athens by Sound See https://vimeo.com/10722818

10- More Information:
This visit is part of a broader initiative and the first of a series of visits to be undertaken by Miguel Paredes, aiming to provide the School of Architecture of the Università degli Studi di Cagliari with increased exposure to research and teaching on contemporary digital design techniques and associated theoretical discourses. For this reason the course will be held in the period: 28 February-7 March and 28 March-13 April. The initial 1-week period will be used to develop the digital survey exercise (1) and set the grounds for the digital mapping exercise (2). Students are expected to develop the digital mapping exercise further between the two teaching periods. The second, 3-week teaching period will be spent critically interrogating and mobilising previous work towards the development of informed design responses.
This course will explore strategies for activating and enhancing urban public space in the context of Cagliari’s historic urban fabric. We will endeavour to further enhance this stimulating urban scenario by designing, situating and fabricating networks of architectural artefacts that will perform as generators of novel, unexpected spatial conditions. Our work will revolve around a sequence of iterative investigations into digital sensing, parametric design and digital fabrication. This will ultimately lead us to the development of proposals that simultaneously address the scales of the city, the street and the human body.
We will work with two prominent themes situated at the forefront of contemporary architectural discourse:
An urbanism of Architectural Devices
On the one hand, we will reflect on the critical role of architecture in the production and the transformation of urban public spaces of metropolitan scale. The position of this course is that, in light of the recent output of most mainstream architectural practices, making individual buildings seems to have become an inadequate strategy to articulate and nurture meaningful urban environments. Therefore, we will be less concerned with designing buildings. Instead, our focus will be on developing networks of multiple active artefacts - which we will refer to as architectural devices- that perform as a distributed spatial network deployed over the historic urban fabric of Cagliari.

Left: Amid-Cero9, ‘4S (Sun, Sex, Sand, Sea): Four Simulation Chambers in Brugge’ (2002). Right: Ja Kyung Kim, ‘Oi, your shadow is over the line’ (2013)

Designing by Prototyping
On the other hand, we will also explore the novel ways in which digital technologies can drive architectural design processes, with an emphasis on iterative making. This will be achieved through explicit investigations into digital sensing, digital computation and digital fabrication, leading to the development of an informed urban analysis and a series of design propositions that articulate meaningful responses to its findings.

Bernd Felsinger. Anticipation Navigator

Cagliari and the urban condition
The historic centre of Cagliari will be a testing ground for practices that activate interaction, public participation and other dynamic programmes that enhance the collective experience of its urban field. The collective domain of public space is the most important urban asset of contemporary cities. Cagliari is a prime example of this: Its dense, varied urban environment provides a rich public identity, which is in continuous transformation through
the ebb and flow of a multiplicity of seasonal events. Continuous friction between different urban agents fosters interaction and the spontaneous emergence of unplanned situations. Although the appeal of cities lies precisely in their diversity and vitality, as city dwellers we often tend to situate ourselves in very restricted spheres of human and spatial interaction, oblivious to the richness and variety of experiences that the urban landscape affords. Conventional architectural strategies (focusing on buildings as their fundamental operative unit) often tend to worsen the tendency towards isolation by imposing a rigid regime of distinctions such as those between the public and private, the open and enclosed, the built and void. This fosters fragmentation and separation rather than facilitating the friction and co-existence of different urban sensibilities.

Activated public space
We will embrace a generous approach to the public sphere, which seeks to emphasise collective interaction while simultaneously revealing and activating latent spatial connections at a metropolitan scale. In doing so, we will explore how the careful deployment of multiple, responsive architectural devices can become an agile, flexible strategy to reorganise, reframe and augment the collective experience of urban space, overcoming the limitations of conventional building typologies and practices. We will also explore what the physical content of these architectural responses may be: light, sound, motion, static or moving image and controlled atmospheric effects will be incorporated to the traditional tectonic palette, becoming rightful components of an augmented architectural surface. In doing so, our design endeavours will deal with the activation of the spatial environment that surrounds our interventions: Architecture will become an input/output public mechanism of human interaction.


Architectures of hedonism
This course will pay special attention to urban activities that seem to inhabit the fringes of the permissive in the conventional collective experience: Pleasure and spectacle, leisure and exuberance will be scrutinised as vehicles for modulating social interaction, and then structured as the programmatic driving forces for architectural proposals that frame, reflect and transform our urban scenario. In order to turn collective hedonism into a productive design force, we will endeavour to map, model and reproduce some of the organisational dynamics that emerge out of central Cagliari’s rich network of interconnected urban phenomena. You will then respond to these emerging conditions by developing proposals that simultaneously operate at the scales of the body, the studio and the city, translating, emphasising or equalizing the urban flow of leisure and hedonism by means of spatial interventions.
Digital & Analogue (Hybrid Species)
Our work will explicitly foster a dialogue between digital and analogue techniques and sensibilities. Its goal is the production of hybrid digital/analogue physical environments that simultaneously describe and transform relevant sets of urban phenomena. Since we conceive these environments as architectural assemblages of both digital and analogue materials, we will proceed by carefully juxtaposing their respective design inputs and exploiting the interactions afforded by the convergence of both domains. Hence collection, mapping and charting of relevant urban phenomena by analogue means will be linked to the digital re-interpretation and modelling of its emerging organisational patterns using custom-built digital tools such as (but not limited to) Grasshopper definitions and Processing sketches. Both sets of information will then be fed into the development of hybrid digital/analogue devices that will demonstrate reactive, dynamic capabilities. Finally, these operations will evolve into tools for informing architectural devices equipped with digitally-driven reactive layers that feed back to their physical environment. To facilitate the fulfilment of this ambition, and as an integral part of a studio culture that cultivates dialogue and sharing of knowledge, a common repository / knowledge base of digital tools, scripts and tips will be made available throughout the course.

Exercises 1 & 2
Developed from February 28th to March 31st
Synopsis
Working in groups you will build a portable device that uses Arduino sensors and Grasshopper to capture and map qualitative and quantitative data within the context of the historic urban environment of Cagliari. Depending on logistics, students may develop their own Arduino instruments or pre-assembled basic instruments can be provided in order to start surveying from Day 1.
Task
The first stage of the brief focuses on modelling a relevant fragment of the urban field of Cagliari from the perspective of events and practices related to leisure and hedonism. You
are expected to explicitly consider the position of your school as an integral part of the aforementioned urban field.

1 - Determine the boundaries and the scope of your area of operation within historic Cagliari, and explicitly situate yourself in this context.

2 - Use your Arduino kit to develop a portable sensing device to capture, record and map qualitative and quantitative data and events related to hedonism within the context of the your chosen area of operation. This sensing device should interface with your computer via Processing or Firefly. You may wish to explore potential interfacing of Arduino with mobile devices, smartphones, etc. Other strands of exploration include image processing or online data capturing via Firefly.

3 - Arduino can be used to read a vast array of different environmental parameters (such as temperature, sound, vibration, light… ) but it is critical that you do not take this reading at face value: Your Arduino kit should be mounted into a device that is carefully engineered and fabricated to exercise these sensing capabilities in meaningful ways. Your instrument may, for example, help filter, focus or extend the range of Arduino sensing. It might be wearable or attachable to specific physical anchors. Bear in mind that the key task of Exercise 1 is to make your sensing kit and your device operate symbiotically.

4 - Conduct an organised survey (or multiple surveys) in your area of operation using your capturing device. Plan your survey ahead: how are you going to proceed and what do you expect to capture?

Restrict your survey to a timeframe of operation that yields as much data as possible. If you feel comfortable with it, you are advised to consider dusk and night times as many critical transformations of the collective urban dynamics take place within those timeframes. While staying within safe boundaries, you are also advised to adopt a radical, exploratory perspective when determining the urban phenomena you will work with. You are expected to develop a good knowledge of uncharted urban realities.

Possible urban phenomena to be surveyed can include (but are not limited to):
- Human/Social aspects: the social activities of specific social groups/urban subcultures, the spatial distribution of such groups, their enclaves, their dress codes or their collective leisure schedules.
- Regulatory aspects: surveillance, policing, opening hours, dress codes, crowd control, CCTV systems.
- Strictly environmental aspects: lights-capes, soundscapes, densities, heat levels, air quality or any physiological indicators.
- Digital urban environments: app-based environments for geo-locating meeting/dating/dining/clubbing and other opportunities.

You should consider how your device can be engineered in order to capture any of the aspects above. For example, the atmosphere of a specific nightclub can be recorded via multiple sensorial stimuli: light, sound, smoke etc.)

5 - Present the results of your survey, highlighting accumulated interactions between heterogeneous urban phenomena, and referring them to the urban fabric of the Old Town. The goal is to make the results of your survey spatially legible and situated with regards to the area you explored. Develop mapping and notating techniques to represent the subjects of your survey, and address the potential role of Adam House as a component of the surveyed domain. You may present your findings as a digital drawing (on screen or projected) and/or a set of multi-layered printouts.
Ling Tan - Interactive Architecture Lab. Reality Mediators, 2013
http://www.interactivearchitecture.org/lab-projects/reality-mediated


Nerea Calvillo, ‘In the Air’ (2008), http://intheair.es/index.html
Data sources and data collection specifics
An enormous amount of information can be collected using a combination of Arduino sensors, Rhinoceros and Grasshopper and mobile phones. As starting point, students may consider the following:

**Using Arduino boards and simple sensor circuits.**
- Light levels (visible light or parts of the colour spectrum also infrared with an appropriate sensor)
- Temperature levels
- Presence - via photoelectric sensors (i.e. numbers of people crossing specific thresholds, speed of movement between two sensors, obstructions, etc.)
- Sound levels (noise, etc.)
- Tilt (i.e. inclination of ground plane, body movements in space etc.)
- Vibration (i.e. texture of surfaces, body movements in space etc.)
Please note that these sensing devices work best if they are ‘wearable’ (i.e. their measurements relate to the movements and the experience of the human body as the urban space in question is analysed, hence fostering a form of ‘subjective’ sensing).

**Using Android phones:**
- GPS coordinates (as a live stream or a route file)
- Live data from phone gyroscope (tilt, inclination)

**Using webcams or digital cameras:**
- Video or still image analysis (colour, texture, movement, optical flow, contour)

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**EXERCISE 3**

*Developed from April 3rd to April 12th*

Architecture is constructed from a seemingly endless number of simultaneous ontologies – concurrent worlds, subjectivities, temporalities, realities, value systems. Architecture is a venue where these value systems (or realities, etc.) compete and struggle to enfranchise an audience, to produce identity and codify themselves into recognizable and meaningful discourses.

Quote from “Post-Medium-Specific-Architecture” Michael Meredith (2013)

**Synopsis**

Exercise 1 invited you to consider urban phenomena as ‘inputs’ that could be digitally recorded with appropriate instruments. Exercise 2 asked you to develop an understanding of the data you recorded and redeploy this knowledge in the form of a hybrid analogue/digital survey. Now, Exercise 3 invites you to redeploy your findings back into the urban space by designing reactive architectural machines that generate spatial responses to the conditions that were initially observed. In doing so, the ‘outputs’ of your spatial interventions will start defining potential transformations of the public domain in which they are installed. You are expected to produce an architectural proposition with a comprehensive design argument. Your design endeavours will focus on developing a network of public space activators operating in relevant sites within historic Cagliari.

**Task**

After developing a spatial reading of the city in the design studio, you will now work in reverse by scaling up the outputs of your reading in the form of a long-range, distributed network of public space interventions. You will determine the functionality, distribution and contextual responses of the architectural devices that populate this network. Bear in mind that architectural devices are neither ‘follies’ (devoid of any functional intent) nor buildings (responding to traditional typological classifications such as library, theatre, etc.). They should have a well-defined programmatic intent which explicitly taps into your work on hedonistic practices, in the context of historic Cagliari. Consider the opportunities afforded by linking together the urban scale, the scale of the architectural device and the scale of the human body in order to articulate transformative processes and programs that lead to the social, economic and cultural improvement of central Cagliari.

In tune with the overarching ambitions of this brief, your architectural devices should be conceived as hybrid digital/physical environments that link human interaction within diverse flows of information. It is up to you to determine the specific nature of this interaction, the way it might take place and what the balance between digital and physical components might be. As a general rule, you are expected to put special emphasis on collective/individual human interaction as a way of establishing relevant forms of urban dialogue. It is expected that, as your output will progressively gravitate towards the physical materialisation of your proposals, your temporary appropriation of the studio space will become a project in itself. Consider your proposals as an assemblage of physical and digital media that link specific phenomena at the urban scale with bodily interaction at the human scale. The spatial response of your proposal can take many different forms: movement, projections, sound, etc. (or combinations of those) but it should always...
demonstrate a critical position towards the urban phenomena it is reacting to. You proposal(s) should also incorporate some degree of human interaction in order to orchestrate the way information is re-calibrated and re-presented to the public.


Cheryl Baxter, Fantastic Trailer (2012)

Jean Michel Crettaz, Imum Coeli – Pendulum Field (2013)
Manifesto

Subverting data-based design practices to reconstruct the public domain(s)

The proposed course contribution is two-fold. Firstly, it will critically discuss a number of very recent techno-informational practices gravitating around the notion of ‘sensing’ and focusing on the development of physical, real-time responses to ‘sensed’ data streams within the specific context of urban public space. The processes and outputs of these practices will be approached from both a technical and a socio-political perspective, paying special attention to the operative affordances and limitations emerging at the intersection of both domains. For example with regards to the scale of the resulting interventions, their target audience(s) and the restricted nature of the datasets they tend to respond to. This analysis intends to foreground the critical agency of architecture in both the production and the transformation of urban public space, and also emphasise the non-neutral role of digital technologies in shaping those processes.

Secondly, this contribution will endeavour to produce a series of architectural interventions developed in the context of the design studio that articulate a methodological counter-project to the practices described above, attempting to subvert the prevalent discourses of the ‘urban sensing’ project such as optimisation, efficiency, atomisation and ‘smartness’.

These interventions operate within the same technical domain as the practices mentioned in the previous paragraph - actively engaging with available digital data sensing and processing techniques. However, they differ in their attempt to facilitate the emergence of both individual and shared subjectivities through the critically informed development of a sequence of operations hybridising materiality and data: Sensing Instruments, Maps and Responsive Propositions. From a programmatic standpoint, this sequence focuses on hedonistic urban activities that exist in the fringes of the permissive in the conventional experience of the collective (such as pleasure and spectacle, leisure and exuberance). These subjectively sensed materials and the resulting responsive prototypes tackle issues concerning friction and collectiveness in dense, historic city centres, and formalise design narratives that explicitly re-situate the locus of operation in the domain of the commons.

By presenting together these two approaches to digital, data-based design, this contribution will endeavour to open a space for critical reflection on charged, pervasive terms such as ‘flow’ or ‘network’ acknowledging their non-neutral political nature but also their potential to inform creative strategies that actively resist the mainstream discourses of public space governance.