

Semester Project – Research plan

Development of an Interactive Installation on Urban Photovoltaic

Student: Rino Sogno (sognor@student.ethz.ch)
Examiner: Prof. Dr. Arno Schlueter (schlueter@arch.ethz.ch)
Supervisor: Dr. Christoph Waibel (waibel@arch.ethz.ch)
Starting date: 12.07.2023
End date: 13.10.2023 (FCL exhibition end)
Work load: 6 ECTS = 150h-180h

A Introduction

As part of the international Future Cities Laboratories (FCL) conference to be conducted in October 2023, the FCL research program will be hosting a public exhibition in the main hall of the ETH Zurich main building. The goal of FCL is to help shaping sustainable cities and settlement systems through science, by design, in place, and over time.

Within FCL, the "Powering the City" (POW) module, an international consortium of researchers from Singapore, Sweden, Switzerland, and the USA, will be represented with an exhibition stand to showcase their ongoing research. The objective of the module is to investigate the deployment of building-integrated photovoltaics (BIPV) in urban environments, with themes revolving around it, such as socioeconomics, decentralized renewable energy, Vehicle-to-Grid, life cycle emissions, and architectural design.

For the POW exhibition stand, we aim to develop an interactive installation, involving electronic (and potentially mechanic) artefacts displaying the sun paths of Singapore and Zurich, as well as interactive data visualization techniques involving Augmented Reality (AR). The stand will combine information of the ongoing research, physical objects of BIPV panel prototypes, the interactive artefacts, as well as (touch-) screens to interact with the artefacts.

B Goals and Objectives

Within the aforementioned framework, this semester project is focused on the conceptualization, detailing and fabrication of the interactive artefact visualising the sun paths for the two studied locations (Zurich and Singapore).

The main goal is to decide upon the mode of visualisation (mechanical, light sources, etc.), the information visualisation control using an Arduino board, and to determine the design of the artefact as an art object. Once a final concept is derived, construction plans and details will be produced, such that the artefact can be manufactured with the support of the internal ETH wood- and metal workshop services.

The following main milestones were recognised:

- Prototyping of the representation of the city scape (potentially 3D printed).
- Exploration of several technical options on how to visualize the sun path. This involves a static element showing the bounds of the sun paths (solstices) and some chosen sun paths, which could potentially be made from metal or wood. On the other hand, there is an interactive element (eg. using an LED-Mesh, using individual LEDS, using a mechanical element, a moving

belt, or similar) to dynamically visualize the sun position or other information for different scenarios.

- This exploration is followed by a prototyping and ideation of the possible realizations of the most promising concepts on a small scale to prove its feasibility and visualization potential.
- This is combined with an exploration of the potential to show further information beyond the sun path (eg. PV penetration, grid emissions, temperature of the hour in a TMY, etc.) using the interactive representation of the sun. This involves programming a board (such as an Arduino) as a controller using the data given.
- Potentially creating a connection to an interface allowing the visitor to play (potentially involving “mini games”) or interact with the information shown and decide what he wants to see. This topic has an overlap with another ongoing semester project developing the AR setup and depends on the data given from the simulations.
- Once a final concept is chosen, production plans and details will be drawn. These will be discussed with the respective ETH workshops and handed to them, such that the final product can be produced at its actual scale for the exhibition in October.

C Methods

As this project involves benchmarking different realisations in terms of visual expressions, data visualisation possibility and the aspect of an interactive interaction with the installation, small scale prototypes will be built to prove the feasibility, interactive visualisation capabilities and the visual appearance of the art object.

The interactive aspect will be developed simultaneously using a micro controller board, such as an Arduino, which will needed to be programmed with respect to the chosen representation. Technical aspects as well as products available need to be checked and tested.

In the last step production plans will be drawn using a CAD software.

D References

- [1] Heliodon: <https://www.epfl.ch/labs/lipid/laboratory-team/laboratory-facilities/>
- [2] Interactive Town Map: <https://blog.arduino.cc/2016/09/15/a-community-made-arduino-powered-interactive-town-map/>
- [3] Sensing the City Exhibition: <https://www.andreamuxel.com/teaching/sensing-the-city/>
- [4] Heliodon Arduino: <https://www.youtube.com/watch?v=HqACH3WS-w8>
- [5] Physical Simulation of Dynamic Daylighting Conditions in Scale Architectural Models: <https://www.ashrae.org/file%20library/conferences/specialty%20conferences/2020%20building%20performance/papers/d-bsc20-c014.pdf>

E Planned Deliverables

Mid-term presentation:	At the middle of the project, the work will be presented to the supervisors and interested persons for feedback.
Draft report:	1 week prior to the final presentation a pdf of the draft report will be sent to the supervisors.
Final presentation:	At the end of the project, the work will be presented to the chair during a group meeting or equivalent.
Final report:	Final report (PDF, hard copy, simulation files, ...) is due on/before the end date.