

PRINCIPAL ACADEMIC TUTOR
Maria Luisa Virginia Collina,
Dean of the School of Design,
Politecnico di Milano

ACADEMIC TUTOR
Venanzio Arquilla, Department of
Design, Politecnico di Milano
Laura Daglio, Department of
Architecture, Politecnico di Milano
Maurizio Vrenna, Department of
Design, Politecnico di Torino

EXTERNAL INSTITUTIONS
Artemide; Deloitte

EXTERNAL TUTOR
Carlotta de Bevilacqua, Artemide
Laura Pessoni, Artemide
Fabio Zanola, Artemide

TEAM MEMBERS



Riccardo Ronzani,
Architecture,
Politecnico di Torino



**Satyesh Shanker
Awasthi,**
Mechanical eng.,
Politecnico di Milano



Lorenzo Granata,
Control eng.,
Politecnico di Milano



Maria Stella Lux,
Architecture,
Politecnico di Torino



Aurora Maggio,
Architecture,
Politecnico di Milano



Jacopo Paganelli,
Biomedical eng.,
Politecnico di Milano

Light&SENSEable city - triLIGHT

Executive summary

Our project investigates the **light** to help **cities** become **smarter** and more **sensible**. Our **multidisciplinary** team worked with Artemide S.p.A., a leader in light design, and with the consultancy of Deloitte.

We designed an **innovative, interactive urban system sustainable socially** (bringing closer the community promoting interactivity for the users' needs), **economically** (being feasible and implementable thanks to modularity), **environmentally** (reducing the energy footprint, generating healthy oasis inside polluted-busy cities). It valorizes the spaces through **beautification** creating a **safer** and attractive atmosphere. It was developed a **modular flexible** structure for the valorization of urban spaces and of the daily people experience, a **system of devices**, whose configuration is **adaptable** to different scenarios. The module is a **triangular transparent unit** with a thin **opaque frame** with technological components. The triangle has been chosen to build any other shape for the specific site. Light is provided by the latest LED, increasing intensity according to natural conditions and the activity below, promoting its efficiency within the photovoltaic cells, while photocatalytic paint captures pollution. In a synergic union, the project is system of autonomous units, advantage for maintenance where even in complex structures, each problem can be located in a single unit.

Stazione Centrale (Mi) was chosen for contextualizing while always taking into account the objective of scalability. A multi-layered masterplan showed where to place the modules to maximize the benefits. Other scenarios and structures are conceivable using our modules just bringing minimal adjustments. Transparent base units may be assembled in dynamic facades of buildings or for pavilions. The takeaway is a marketable product, which opens a range of endless innovative solutions for cities. The objectives were achieved, while keeping it open to future implementation. The solution takes part in the transformation of critical urban areas into smart places: it could become part of a collective strategy towards new balances between society and urbanity.

Key Words

light | interaction | sensible device | urban environment | sustainability



3D representation during sunny days, cloudy ones, sunset and night

△.triLIGHT



**Project description
written by the
Principal Academic
Tutor**

Light as smart energetic infrastructure

Tomorrow's city is a key topic for innovation research. It is a junction between many issues concerning people's lives: light, data transmission, mobility, safety and pollution, amongst others. Starting from an understanding of Light as a necessary infrastructure within the urban context, the course will aim to develop an innovative and sense-able network which, using energy in all its declinations, expands beyond the light field. As the human being is at the center of the SENSE-able city where different private and public actors share objectives and responsibilities. A cutting-edge design system that improves life quality for the city-ecosystem of the future, providing innovative services for urban spaces and their inhabitants.

The course had three main goals:

- **Creation of responsive and interactive spaces** in an urban context where the threshold between indoor and outdoor is increasingly blurred and where the interactions between different actors of the city are more and more dynamic.
- **Design of an open platform**, starting from light, where smart spaces are increasingly related thanks to the technological settings which enable the interaction amongst people.
- The emerged proposal is an applicable solution not only from a functional point of view, but also from an aesthetic, perceptive and social standpoint. It can be seen as a **lighting eco-system**, able to create a new generation of products in order to improve liveability in urban spaces, with a particular attention to crossroads of flows and people. **It starts from a clear context, as a site-specific project, but it becomes and Incremental infrastructure**, fluid, back compatible and upgradable in its performances.

**Team description by
skill**

The group work has been structured according to the specific competences of each member and also respecting an internal distribution of roles and responsibilities. Interdisciplinarity allowed us to study the project from different points of view: from the most technological and detailed, to the impact it creates in the public space; from the aesthetic value, the beautification of the place, which is linked to the social value as characterizing the identity of a place, to its subsequent redevelopment; from environmental to economic sustainability. Individual and group work have both been of fundamental importance.

The team consists of the architects Riccardo Ronzani, team leader, Maria Stella Lux, responsible of technological details and prototyping and Aurora Maggio, finance and management responsible; a mechanical engineer, Satyesh Shanker Awasthi, that curated mostly the innovation and technologies part; a control engineer, Lorenzo Granata, the communication responsible; a biomedical engineer, Jacopo Paganelli, responsible of research and analysis phase;

A sensitive light for urban space was the theme of the project proposed by Artemide, an Italian company established in the field of lighting and design. In particular, we worked with Carlotta de Bevilacqua, Laura Pessoni and Fabio Zanola, respectively the CEO, designer and engineer of the Artemide group, for the first phase of theme analysis and concept design, and with professionals indicated by them for the development of the drawings, more technical systems and the prototype. The whole process was coordinated and followed by Professor Luisa Collina, dean of the design school of the Politecnico di Milano, with the support of Professor Venanzio Arquilla, Maurizio Vrenna, Ilaria Bollati, Research Fellow at Politecnico di Milano, and Professor Laura Daglio, for the technological-structural part.

Goal

Our project aims at investigating the potential of light and its use to develop a viable and feasible idea with light energy at its nucleus to help the cities become smarter and more sensible.

The project aims to design an innovative, interactive urban device that must respond to some fundamental requirements, that are:

- **Social Sustainability** The project has to bring the community and society closer, introducing inclusive interaction and promoting interactivity to cater to the needs of the users. Beautification and valorization of urban spaces should create a safer and more attractive environment.

- **Economic Sustainability** The project must be feasible and implementable immediately, while having a life-span able to accommodate possible future tweaks. In addition, modularity and scalability are essential objectives, in order to develop an adaptive universal solution.

- **Environmental Sustainability** The project should consciously work towards reducing the energy footprint and prevent degradation of the environment and its inhabitants; it should also generate a healthy oasis for the citizens inside polluted and busy urban environments.

Needs and requirements of the primary Actors and Stakeholders were mapped in order to enrich the list of objectives with more specific requirements. The innovative quotient of the project is bound to be high, with the goal of offering a system of feasible solutions to the complex and multilateral problems present today. Notwithstanding the fact that the project has its efficiency and effectiveness, it should be pleasing to the eye and enhance the aesthetic appeal of the locations where it is based, contributing to the creation of a valued and attractive city.

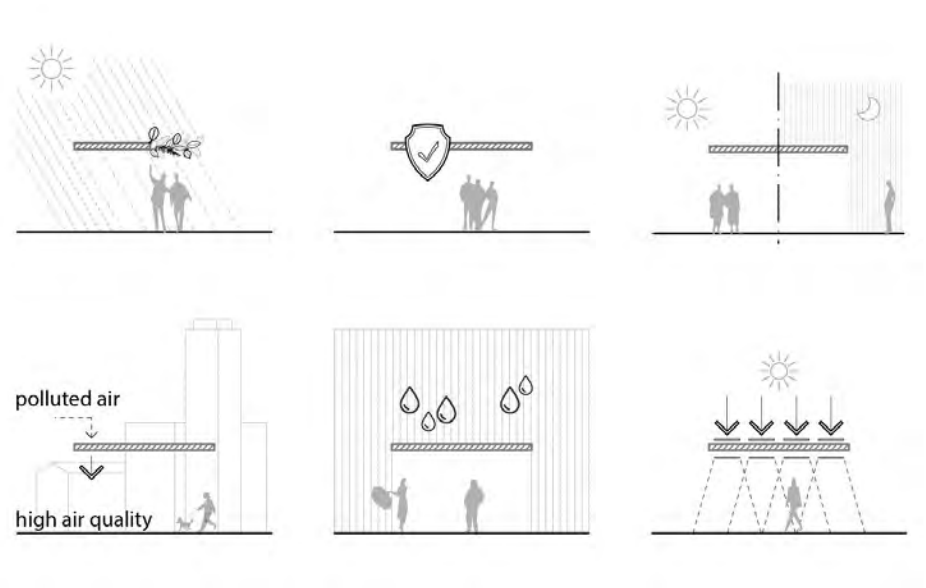
Understanding the problem

To achieve the objectives, a deep research of light in different contexts of science and engineering, society and culture, energy, environment and data transfer were performed at the beginning of the design process. The analysis phase proceeded in parallel with the identification of possible issues to be tackled specific to cities, as for example pollution, lack of safety, psychological impacts and loneliness, lack of inclusion, increasing population density and decreasing green coverage.

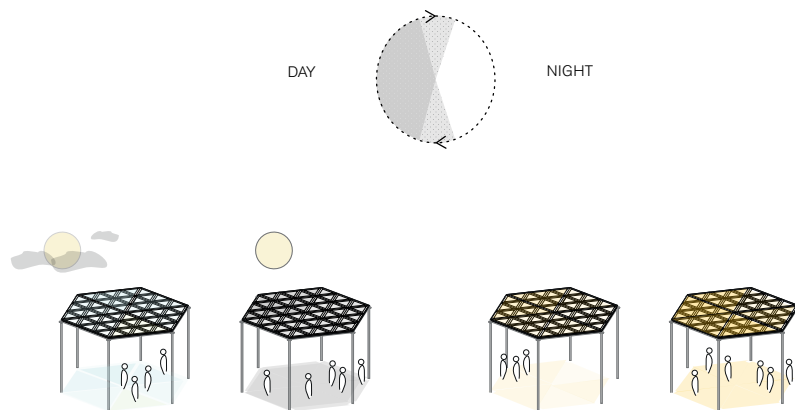
Cities of today are complex and problematic. Urban contexts are characterized by a casual overlapping of dynamics that often produce a chaotic perception in spaces, unable to respond to the real needs of citizens. Over the last decades, these issues have led to the conception of an innovative type of city: a city capable to be in touch with its inhabitants, producing positive synergic interactions. As a result of several academic studies and innovative urban experiences, the concept of smart city was born, and has ever since been growing in importance. For the purpose of a future smart city, a conscious and intelligent use of light plays a fundamental role. Along with responding to practical needs and that of safety, light can influence circadian rhythms of humans and plants, having an impact on the psychological well-being and the social behavior, and can play a key role in the maintenance of an ecosystem.

While dealing with a "light sense-able city", the main stakeholders are Artemide and the municipality of Milano, so public utility and social value are required as final outcome while the company's needs a luminous object that responds to its identity: the aesthetic quality, materials and classic line that have always characterized them, and the technological innovation towards which they aim. At the same time, economic feasibility must be taken into consideration, drawing up a plan that leads to a standardized, modular and scalable production.

The method of generating the design concept describes how the needs of the stakeholders were translated into project requirements. A precise definition of the problem was necessary both for the concept generation and for the definition of the product in detail: we followed a structured analysis, research, identification of problems and solutions, and definition of the final choice.



Concept schemes of the shelter functions



Sensibility and interactivity of the horizontal layer

Exploring the opportunities

Having a strong belief that interdisciplinarity could benefit the project, inspirations and references were sought in the world of nature and art. Sensible light and human centered design hypothesis developed, using in different ways light or technologies, were compared highlighting their potentials and weaknesses according the fundamental objectives or the problems to solve, the stakeholders involved, the specificity and scalability of the project. We wrote a manifesto containing the guidelines and the main objectives: L.I.G.H.T. (Light Interaction for Growing Human and Towns). Milan Stazione Centrale, at first, contextualized it in a frame of actual problems and users, while always taking into account the objective of a scalable project: a practical example of how to use the proposal in different scenario analyzing the location and its dynamics. A smart system for beautification and valorization of the environment through an adaptive modular structure.

Generating a solution

During the process we developed the idea of a modular adaptive structure for the valorization of urban spaces and the enrichment of the daily experiences of people. The idea was conceived as a modular system of devices, whose configuration can be developed and adapted in different scenarios. The module, the basic unit of a smart structure, is thus a tool to generate a series of possible urban outcomes.

The basic unit is a transparent triangle with a thin opaque frame that contains all technological and electrical components. The triangular shape has been chosen since it can be used to build any other shape, according to the specific project site. The key point of the idea is to instill dynamism in the module behaviour with respect to the natural light conditions and the presence of people. To accommodate for the variety of different seasons, the difference between usage during the day and night and the different end users, we provided a set of technologies to our structure.

Environmental sustainability is provided by photovoltaic cells and specific strategies for guaranteeing a good air quality, as for example photocatalytic paint, to capture pollution from the air. It gives color to the whole playground, an healthy oasis where everyone can live a personal experience of the urban space.

All the project choices are coherent with the principle of modularity and, according to the objective of economic sustainability, they ensure the possibility of standardized industrial production and advantages for maintenance issues where even in complex structures, each problem or malfunction can be located in a single unit.

The takeaway of our design experience is a feasible and marketable product, which opens up a range of potentially endless innovative solutions for cities. Thus, using light as a pivotal element in the project, the intended objectives were achieved, while keeping it open to future solutions and implementation. The solution presented, actively and innovatively takes part in the transformation of critical urban areas into smart places: it has the potential to become part of a collective strategy aimed at establishing new balances between society and urban spaces.

Main bibliographic references

Rossi Maurizio , *Design della luce*, Maggioli Editore, 2008.

Frova Maurizio, *Luce, colore, visione: perché si vede ciò che si vede*, Rizzoli, Milano, 2000

Basiago A.D., *Economic, social, and environmental sustainability in development theory and urban planning practice*, The Environmentalist 19, pages 145-161, 1999

Sloane Mona, Slater Don, Entwistle Joanne, *Tackling social inequalities in public lighting*, May 2016

European Commission, Directorate General for Regional Policy, *Cities of Tomorrow: Challenges, visions, ways forward*, Unit C.2 - Urban Development, Territorial Cohesion, October 2011

Stolterman Erik, Janlert Lars-Erik , *Things that keep us busy: the elements of interaction*, Mit Pr, 2017