POLITECNICO DI TORINO
Master of Science in Sustainable Architecture
Honors theses

BIOCLAD: Adaptive_Biodigital Cladding System
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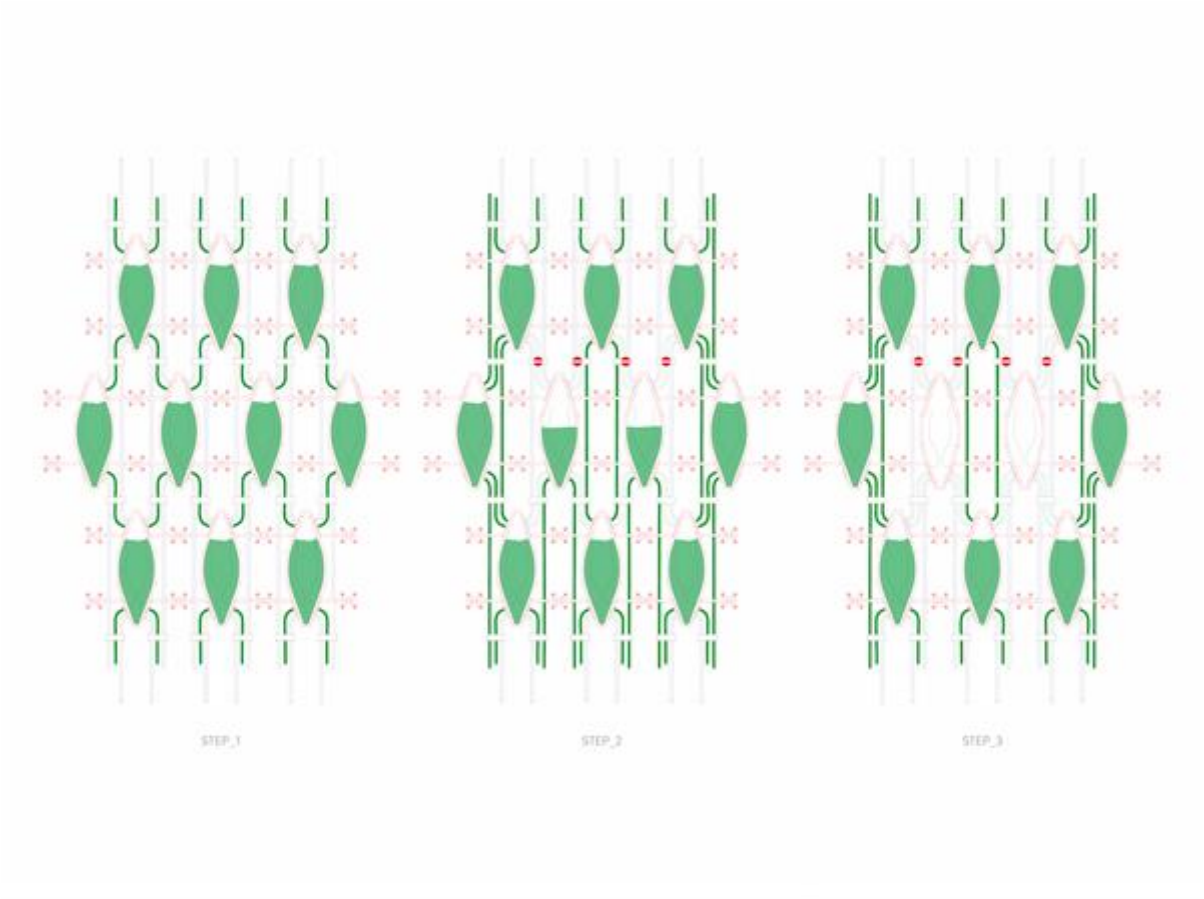
Night view of the cladding system

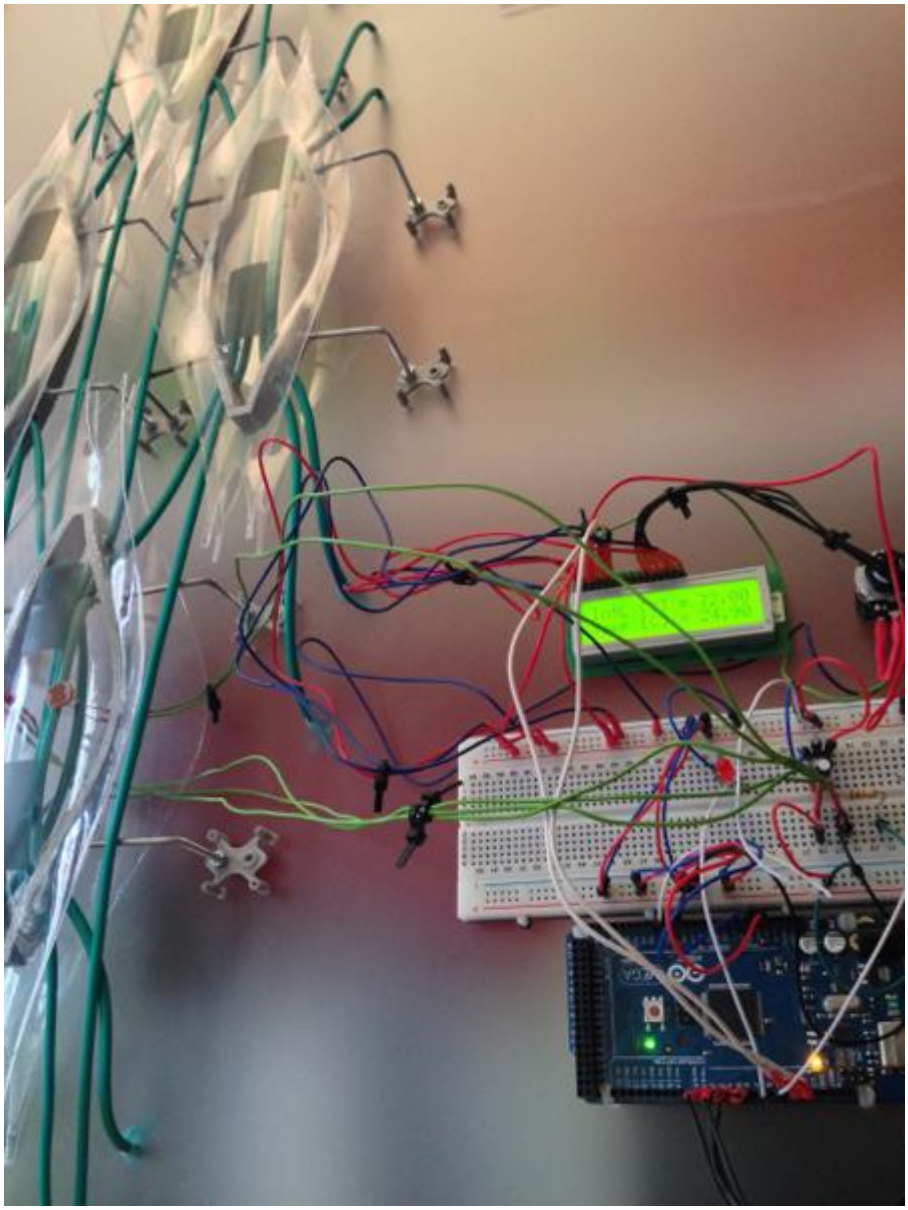
BIOCLAD is an adaptive biodigital cladding system for the cultivation of microalgae able to transform the solar energy into chemical energy through the photosynthetic process, fixing CO2 and producing O2. Microalgae function as a sort of micro biorefinery, from their biomass can be extracted proteins for the food industry, omega 3 and amino acids for the nutraceutical industry, cosmetic and pharmaceutical molecules, bioplastics and biofuels such as ethanol and biodiesel. The allocation of a sensor system able to map in real time the environmental conditions and using data as input for mechanical and biological transformations, allows to propagate the autonomous intelligence of the single component to a system of components defining a system of distributed intelligence.

The ability to self-management and self-definition given by the system of sensors and solenoid valves joins the natural biological capacity of microorganisms present within the components to adapt to environmental conditions by carrying out metabolic processes of growth and oxygen production, forming a coherent and performing system.



Adaptation phases: the solution is driven in the most performative (growth parameters) areas of the surface

The project proposal is the definition of a technological system based on the integration of self-specificity of the microbiological processes of algal cells, and the benefits that they can be obtained at the architectural and urban scale through the development of a coating opaque envelopes. The process of defining the project was done through a path in step: the first of these was the geometric definition of the component through the use of parametric modeling techniques, which are necessary for the control of complex NURBS surfaces, patterns and gradients via attractors points. Second phase is the definition of the hydraulic system necessary for the management and distribution of algal solution within the entire system.



1: 5 Prototype with artificial intelligence

To the project proposal is succeeded by the manufacturing of a prototype in 1: 5 scale of a series of four components; this occurred through the use of digital manufacturing technologies in numeric control and not, as the three-dimensional printing (STL), laser cutting and thermo vacuum forming. The prototype was also equipped with an artificial intelligence thanks to the use of an Arduino platform and the application of a system of sensors (temperature and light intensity) able to simulate the actual properties of the adaptive real technological system.

Central appears to be the desire to interpret the systemic functioning of biological processes and integrate the technological component of the system, giving it the ability to support itself as it does in the metabolic processes of natural organisms.

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