CASE STUDY GREENHOUSE

THE CUSTOMER

The project was born from a collaboration between eLabor and the University of Pisa, with the goal of developing a tool to support scientific research and teaching in the field of automation and environmental control. The client needed to accurately simulate the behavior of a greenhouse, relying on mathematical models validated by the scientific literature, with an accessible interface and a tool that could be easily adopted in educational contexts.

NEEDS

The primary requirement was a web-based software system capable of simulating the dynamic behavior of a greenhouse, starting from a series of scientific equations. This simulator needed to be useful not only for making predictions under specific conditions, but also to support academic research on control, optimization, and analysis issues. Furthermore, it was important that the platform be suitable for educational use, facilitating interactive learning among students. The system needed to be flexible, capable of managing multiple greenhouse configurations, accepting input data from standard files (such as CSV and JSON), running customizable simulations, displaying results graphically, and allowing for data export. All of this needed to be based on open source technologies, in line with the goal of releasing the solution under a free license (GPLv3), making it a shared asset within the scientific and academic community.

THE PROJECT

eLabor responded to these needs with the GreenHouse project, a web application developed entirely with open source technologies. GreenHouse allows users to configure and store multiple virtual greenhouses, each with specific parameters, import input data sets from structured files, and launch simulations through a simple and intuitive interface. The platform allows simulation results to be visualized in real time using interactive graphs, also offering temporal navigation tools within the data. Once the simulation is complete, the results can be exported for further analysis or archiving.
The user interface was designed to ensure a smooth user experience even for non-expert users, thanks to the use of modern web technologies such as HTML, CSS, Bootstrap, and JSP. The system is based on Java EE, uses Spring for the application logic and MongoDB as the database, and is easily installed on both internal university servers and cloud platforms.

A PRACTICAL AND FLEXIBLE SOLUTION

The project led to the development of practical, flexible, and easy-to-use software that allows for comprehensive simulation of greenhouse operation. The GreenHouse application has proven useful for both research and teaching, thanks to its ability to clearly demonstrate how environmental variables change based on different initial conditions. The open-source approach chosen by eLabor ensures the project's long-term viability: GreenHouse can be updated, improved, and shared by researchers, students, and teachers. This work demonstrates how technology can be used to serve science and education, offering useful, accessible, and sustainable tools. At a time when environmental control and energy conservation are crucial, a simulator like GreenHouse can help connect theory to practice.

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