

Developing an Automated Reaction Set-up

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Introduction

The Light-Up project aims to optimize photochemical reactions using light as a sustainable energy source. Flow reactors, which enhance light energy absorption, are commonly employed in photochemical reactions to contribute to the transition toward a climate-neutral society (fig. 1).

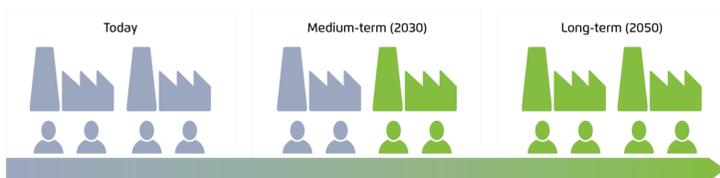


Fig. 1: The transformation of a basic industrial company on the road to climate-neutral production. [1]

This research aims to create an automated reaction set-up for the project. This reaction set-up should be capable of accepting different pumps and reactors, so the user can adapt it to their needs. Also, a security protocol will be developed. This protocol will allow reactions to safely run without the need for supervision.

Materials & Method

The software used in this research was developed using LabVIEW's programming environment and in partnership with BearTree.



Fig. 2: LabView. [2]

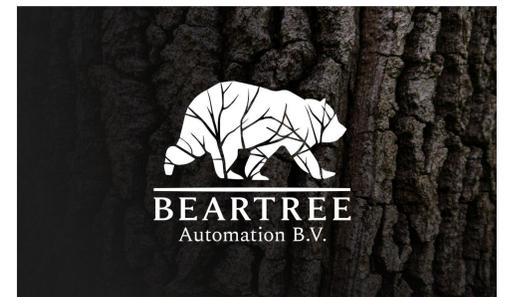


Fig. 3: BearTree Automation B.V. [3]

In this research, individual drivers for the available equipment and a security protocol were developed. BearTree will be responsible for integrating those drivers into a functional software.

Results & Discussion

Table. 1: Automated Equipment

Manufacturer - Name	Type
Knauer – Azura P 4.1S and P 2.1S	Piston Pumps
Chemyx – Fusion 200	Dual-channel Syringe Pump
Huber – Ministat 230	Cooling Bath Circulation Thermostat
Bronkhorst – EL-FLOW	Digital Thermal Mass Flow Controller for Gases
Bronkhorst – EL-PRESS	Digital Electronic Back Pressure Controller

A reaction set-up was made to test the security protocol (fig 4.). In this reaction set-up it is also possible to control the flow speed, pressure limits and temperature via a computer

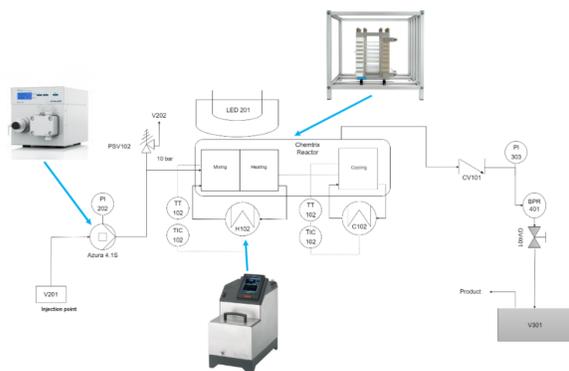


Fig. 4: PI&D of the Developed Security Protocol

By combining the advances made in the research, a PI&D of the desired final reaction set-up was made to serve as a base for future researchers (Fig. 5). This reaction set-up has a gas-feeding system (in blue), a mixer (in yellow) and automatic back pressure controller (in orange). Furthermore, it is possible to change what pumps (in red) and reactors (in green) are going to be used, by selecting them on the software. Finally, it will also have a security protocol, ensuring that reactions can be safely run without supervision.

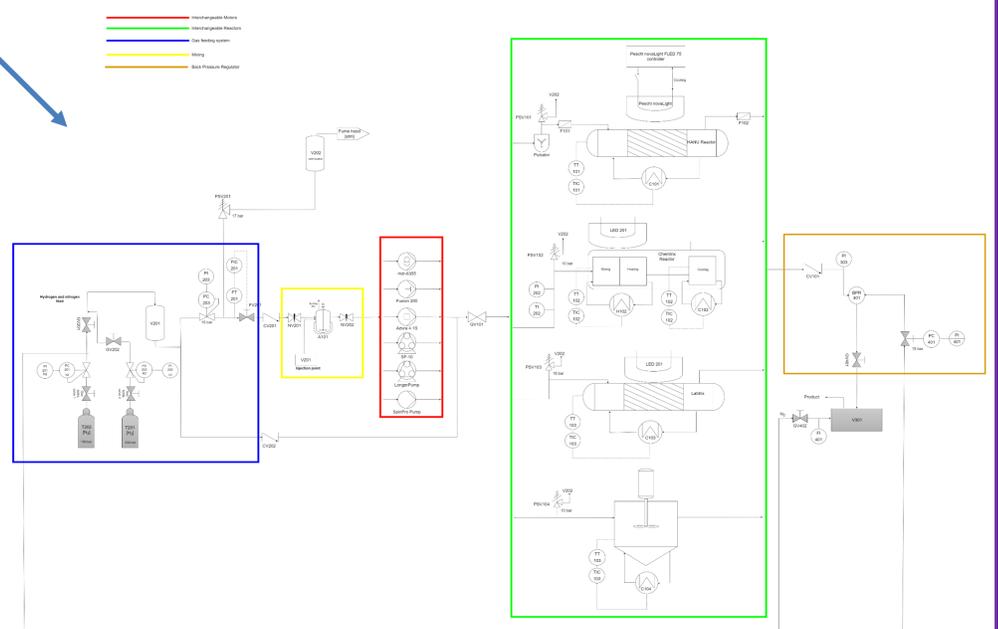


Fig. 5: Desired Reaction Set-Up

Conclusion & Recommendation

- Six different pieces of equipment were successfully automated.
- A security protocol was developed and can be used as a foundation for future programs.
- A PI&D of the desired future reaction set-up was made.
- Using communication via Ethernet ports is recommended for future projects.

Acknowledgment

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[1] Agora Energiewende. (2018). Climate-neutral industry: Strategies for a net-zero emissions future. Agora Energiewende: Retrieved from <https://www.agora-energiewende.de/en/publications/climate-neutral-industry-executive-summary/>
 [2] "What is LabVIEW? Graphical Programming for Test & Measurement." www.ni.com. <https://www.ni.com/en/shop/labview.html> (accessed Feb. 01, 2024).
 [3] R. van Zanten, "BearTree Automation | Professional LabVIEW development," [Beartree](http://Beartree.nl/en/). <https://beartree.nl/en/> (accessed Feb. 01, 2024).