Electrical Engineering
Energy in Transition

THE HAGUE UNIVERSITY OF APPLIED SCIENCES

DC Project – Living DC-LAB

Implementing Smart DC Gird Techniques In a Student Environment

Client: *The Hague University of Applied Sciences*
Research Group Energy in Transition

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Duration: *Shift 3 & 4*

Start date: *PROk 2020-2021*

Location: *The Hague University of Applied Sciences – Delft*

Theme: *Direct Current Research*

Introduction

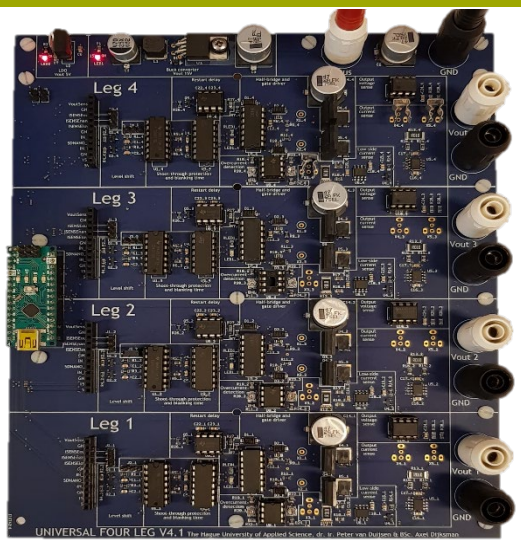
The "energy transition" is a social theme and has major consequences for our future energy supply in a broad sense. When looking at (future) consequences for the electricity grid, there are various aspects that require attention:

- Increasing numbers of electric cars need to be charged.
- Large-scale solar parks will be connected to our electricity grid.
- There will be more electric cooking.
- There will be more electric heating.

Our current electricity grid is not designed for this situation where more electricity is required and there is talk of grid reinforcement to cope with these changes. The step towards strengthening the electricity grid may not be necessary at all if we deal with the situation in a smarter way. The current electricity grid is operated with an AC voltage and we can switch to a DC voltage. As a result, more energy can be transported through the same cable and we have a better control over the current flow. This reduces the need to change to oversized cables. Within this assignment, the focus is on a real ELV-DC-grid. A small 48Vdc grid with small grid-mangers for every load that can send voltage/current to a controller on a central location.

Assignment

The Universal Four Leg (U4L) can be used as a grid manager to control different loads. A new tool we have, is the Universal One Leg (U1L) where a Arduino Nano IOT can be placed to log data (voltage/current) and also change the state of the load. Every leg can be seen as a half bridge, and from the input voltage of 48Vdc you can "buck" the voltage to a lower voltage depending on the load. You will choose the situation for this living lab (Rheon, will be the test location). Think about wireless charging pads, USB charge sockets, LED lights, etc. This situation should consist a typical office setup. A setup we can implement through the whole building. We also need a central location to control all of these IOT devices, the first idea is a Raspberry Pi 4 with an interface like "Home assistant". As a group you are free to discuss the possibilities.



DE HAAGSE HOGESCHOOL

H/DC LAB

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For this assignment we have the following requirements:

- Use the grid managers U4L and U1L (*more U1L need to be assembled if needed, components are in stock*).
- Use multiple Arduino IOT and BLE modules to use in combination with the U4L and U1L.
- Make simulation models (*using CASPOC simulation*) of this office gird situation and determine the power needed for this office grid. This for future battery operation, how long can this Smart DC-Gird operate from a battery pack.
- Get accurate voltage and current measurements from the U4L and U1L and send them to the cloud.
- Use a Raspberry Pi 4 as a server to get the data from the U4L and U1L, define how accurate these measurements are. You can get your inspiration from "Home Assistant".
- Control all the U4L and U1L from the server (Raspberry Pi), next to manual operation there also should be a automation mode where sensor data can be used to make it a Smart DC-Grid.
- Interface should be optimized for a mobile phone.

Deliverables

The following products must be delivered during the assignemntt :

- A plan of approach with an analysis of what is needed to achieve the desired result within the first two weeks.
- Simulation models (if needed) (using CASPOC Simulations). (http://www.caspoc.com/support/download/)
- A new living lab design with all the devices that can run from 48Vdc, also with simulation models.
- Final report in Paper format (not more than 6 pages), include additional Appendix I, II, III (this can be Simulations/PCB-Designs/Measurements,etc.) and all in one LaTaX file.
- Progress report from all students in a weekly progress format, all in one LaTaX file.
- All reporting is done online with Overleaf (LaTaX). (https://www.overleaf.com/) and the online files are shared with the mentors.
- All documents / designs / simulations are shared online trough Microsoft Teams. All organized within folders and sub-folders, all files should have a good name, version numbers and date stamps.
- Design a project poster on A1 format, this poster should be able to sell your product.
- YouTube recording from the Living DC-LAB with a step by step system overview, this should be an educative clip where you give a demonstration, use recorded material you gain during the weeks you work on this project.
- Finished with a Power Point presentation in the assessment-week.

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