Collective Maximum Power Point Tracking

Subject: Elektrotechnik
Thesis advisor : Prof. Dr. Andrea Vezzini
Expert: Peter Kroll (Sputnik Engineering AG)
External project partner: Fondation Antenna Technologies, Genève

The oolux solar power kit offers a modular and easy to use off-grid lighting product. To extend its range of application, a new charging feature named Collective Maximum Power Point Tracking has been implemented. This allows for the direct connecting of multiple oolux PowerBoxes to one large-sized solar panel. The novel “Hungry Sisyphus” algorithm socializes energy harvesters connected to a limited power source. Simultaneously, it ensures adaptive power distribution and extracts the maximum power.

oolux, a story to tell

In developing countries, many remote areas and shantytowns are not connected to a reliable electrical power grid. But because artificial light is essential for school-children’s learning activities and for domestic chores, people in those regions rely on kerosene lamps. These lamps are, however, highly inefficient and their toxic fumes threaten families’ respiratory health. Besides that, kerosene is actually an expensive item for households.

In the past two years, the BFH-TI were intensively involved in developing a new solar lighting system in cooperation with Antenna Technologies and Caritas Switzerland. Field visits to Bangladesh and India inspired members of Institute for Energy and Mobility to create of a solar lighting system called oolux.

Collective MPPT

In several ongoing projects, so-called energy kiosks have been set up in rural villages. These kiosks are essentially mini renewable-energy power stations capable of charging small batteries for lighting use. To simplify and economize such local rental systems, lead acid battery banks should be avoided. It would be favorable to directly connect several PowerBoxes to one large-sized solar panel.

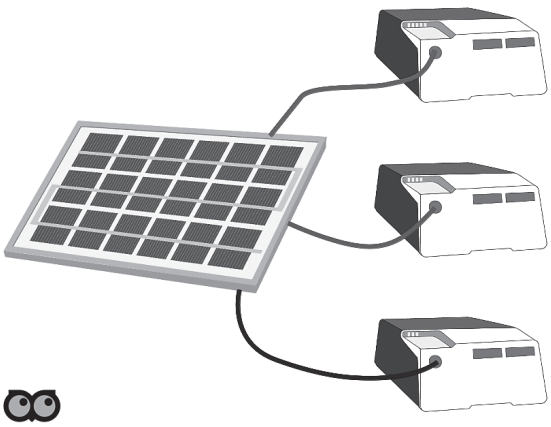
Maximum power point trackers (MPPT) have been designed to work on a single solar power source, such as a solar panel, or on a string. But in certain applications, it would be favorable to run two or multiple MPPT on one solar system. Therefore the Bern University of Applied Sciences launched the Collective MPPT research project looking for new concepts of maximum power point tracking capable of handling adaptive power distribution of single solar systems.

Hungry Sisyphus

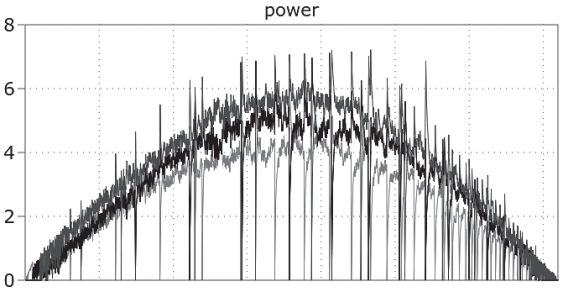
This Master’s Thesis presents a way to implement Collective MPPT into the oolux PowerBox. It proposes a model of a system adaptable to other applications, a maximum power point tracking algorithm with several conceptual explorations, a hardware proposal for low-power application, and a firmware example based on a low-cost microcontroller.

The “Hungry Sisyphus” execution speed depends on the charge level of the battery: the hungrier the PowerBox the more energy it gets. After a certain time, each MPPT leaves the local maximum and restarts from the beginning. This idea arose from the Greek mythological figure of Sisyphus who was punished to roll a boulder up a hill for eternity.

Christ Andri Hassler
christandri.hassler@gmail.com



Several PowerBoxes sharing a solar panel



Power distribution during a day