Calculation of nice („sunny“) days based on small privately owned solar thermal collector systems

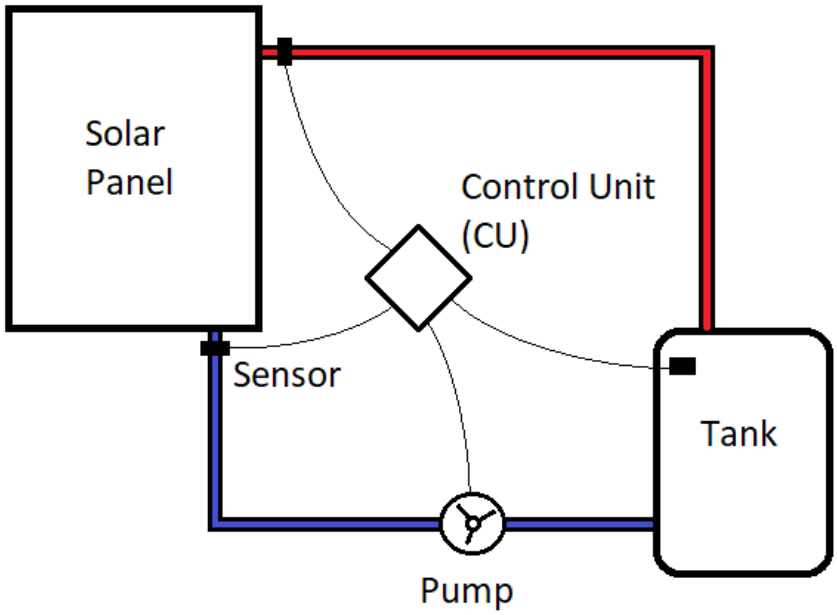
Abstract

The aim of the project is to develop an algorithm that is capable to calculate the amount of sunny („nice“) hours of a day based on data collected by solar thermal collectors used to heat up homes.

To evaluate the algorithm we will use the data collected by an owner of a solar thermal collector system based in Vienna, Austria. The output of this evaluation should be a graph that tells us how many hours of the day could be considered as sunny.

Experiment Description

As input data we will use the data recorded by the control unit of a solar thermal collector. These control units are responsible for triggering pumps based on sensor data. In the following figure you can see the typical setting for a solar thermal collector.



The control unit is regularly probing each sensor to determine the new state for the pump. These control units also log the sensor (in) and control (out) data into an internal storage to allow the owners to monitor that it is working correctly. With our algorithm we want to determine for each of these recorded log entries if it was sunny or not. Then the entries are aggregated to get an amount of sunny hours on each day.
To determine if a log entry is sunny we will use the sensor data measuring the temperature of the hot water exiting the solar panel. If the water is above a certain threshold we can assume that the sun is heating up the solar panel and therefore it has to be sunny outside.

Data description

The control unit that is managing the system of the data we will use is of the type „UVR1611“. This unit stores data for every interval the pump state might be changed, which is configurable.
The UVR1611 has a control software that allows to export the sensor data into a CSV file.

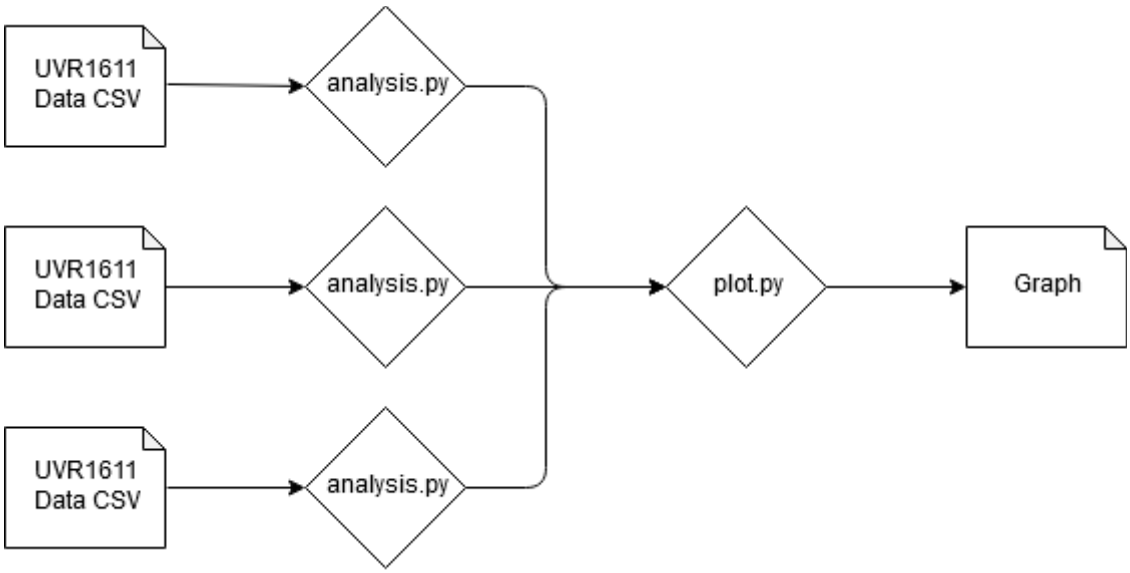
The source data is hosted on Github under: https://github.com/ralf-saenger/sonnenkollektordaten

The provided data stores these log entries for every fifth minute and exists for the days from 2020-01-01 to the afternoon of 2020-04-10.

We get the sensor data measuring the solar energy and the air temperature for each data entry. Of course we are just interested in the first one.

Architecture

First each dataset is analyzed by *analysis.py*. In this step the amount of sunny hours for each day in the dataset is calculated. Afterwards multiple datasets can be visualized together by using *plot.py*.



Output description

This experiment will produce three different types of data:

- The first and most important result is the algorithm used to determine if an entry of data is considered to “sunny”. The program will be written in Python, so this will be a Python program.
- The data generated by the analysis script. This data contains the amount of “sunny” hours for each day of the input data. This data might be reused in a different experiment.
- A graph visualizing the data generated by the analysis script and a program that lets us repeat the visualization.