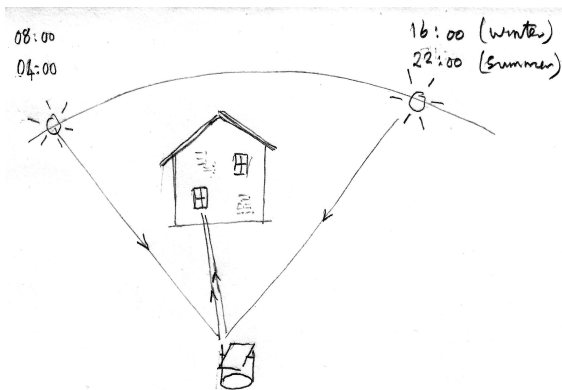
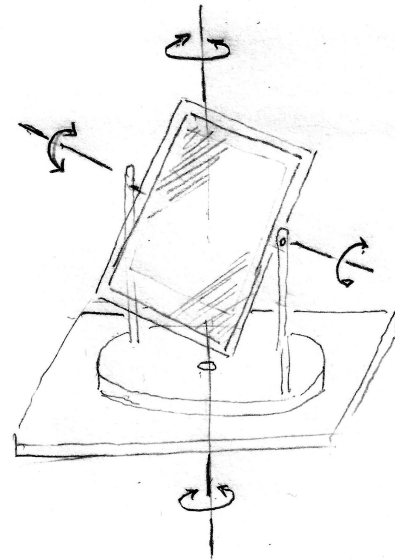


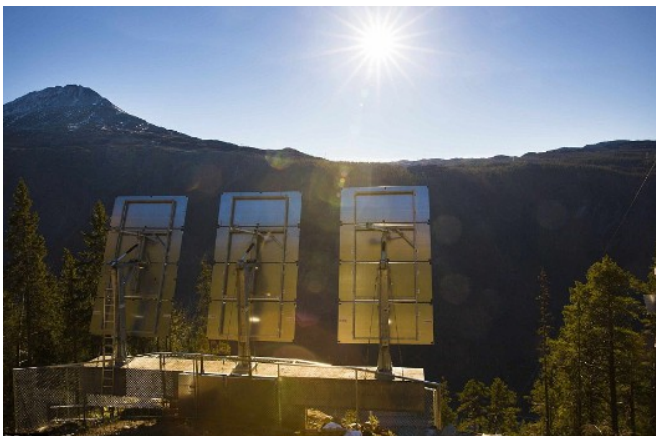
The equipment consists of an ordinary plane mirror (rather like an old fashioned dressing-table mirror) but mounted on a slowly rotating steel framework. Two stepper motors slowly guide the mirror in such a way that sunlight is constantly reflected towards a fixed point, typically through a north-facing window, so as to create sunlit conditions in a room not normally illuminated by direct sunlight.



I tried the idea out with an ordinary fixed mirror sited about 20 m from my north-facing living room window, and found that a 30 x 30 cm mirror is surprisingly effective in creating sunlit conditions inside the room.

The effect inside the room is indistinguishable from direct sunlight, and stunning enough to be quite disorientating at first - something to do with sunlight only normally coming from one direction at a time! The main problem of course, is that you have to keep turning the mirror as the sun slowly tracks across the sky. Today, modern electronics can take care of that.

Similar devices have been used for more than a century to allow astronomical telescopes to track stars and planets across the night sky, so that the engineering know-how is readily available. It might even be possible to adapt off-the-shelf units but I have not been able to confirm this. The maths and control programs are, however, subtly different and need to be custom written.



Recently, a large-scale version of this idea has been installed for two remote villages (in Italy and Norway) which suffer from little or no direct sunshine in the winter months, because of their location on north-facing slopes of steep-sided mountain valleys.

(See for example <https://en.wikipedia.org/wiki/Viganella> and <https://www.theguardian.com/world/video/2013/oct/29/giant-mirrors-reflect-sun-video> )

These devices create therapeutically valuable sunlight and warmth (direct sunlight is about 1kW per

m<sup>2</sup>) at zero energy costs, creating a comfortable ambiance in places normally devoid of sunlight, such as north-facing market squares, playgrounds, coffee shops, restaurants, etc. In northern climates, modern house construction places significant value on a south-facing aspect when siting a house/terrace/conservatory/pool/greenhouse. With a programmable sunlight reflector, virtually every window can have a south-facing aspect as far as sunlight is concerned, and for a price less than the cost of a double glazed window!

The cost of the larger installations puts them beyond the budget of the average householder, but with the advent of cheap reliable and versatile electronics, I believe that an adequate installation can now be put together for less than 100 Euros (parts). Anyway it would be very interesting and great fun to try. It would be a technological curiosity, and brighten up our own homes (always a bonus with the other half!) And who knows, it might even be worthwhile building a few units for friends or neighbours.

The basic components are:

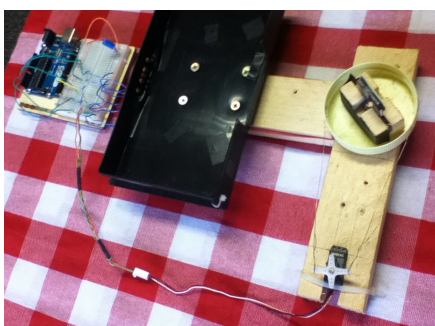
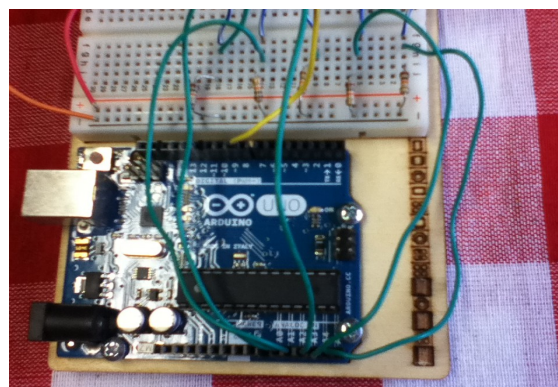
- (1) Plane mirror (glass or acrylic)
- (2) Steel framework with two-axis rotation (vertical/horizontal)
- (3) 2 stepper motors and gear drives to rotate the vertical/horizontal axles
- (4) A programmable microprocessor to activate motors and control mirror position
- (5) 12volt battery/supply to power the motors and microprocessor
- (6) Solar panel to recharge 12volt battery (optional)

### Microprocessor control

A lot depends on the design and construction of the mirror framework, and the degree of accuracy and flexibility required. But I think a good basic design should include the following control functions:

- (1) Two control modes, 'dead-reckoning' and 'seek-hold'
- (2) Dead-reckoning, based on current time and date, to position the mirror to within  $\pm 2^\circ$
- (3) Seek-hold feedback to fine-tune beam position and follow the sun's motion
- (4) A sleep mode for night/overcast/unsuitable conditions
- (5) A manual setup mode to set mirror position during initialization/reset
- (6) Perhaps a memory facility to refine day-to-day tracking

Very versatile and inexpensive programmable microprocessors like the Arduino are now available online with a comprehensive range of add-on accessories. These units can be programmed, tested, uploaded/downloaded and monitored from a personal computer, either wirelessly or onsite. The programming is relatively simple and user friendly. (See for example the Arduino range at <https://www.arduino.cc/> )



I constructed a demo unit to try out the basic seek-hold function but a lack of engineering know-how prevented me from getting further than a crude mock up. I did try adapting the front forks of an old bicycle, which at the time seemed an inspired idea with its two perpendicular axles and bearings already in place, but my metal working skills are very sadly limited!

I have the necessary electronic hardware to prototype the idea, plus a few stepper motors and various other electronic accessories, but no engineering equipment or materials. The basic seek-hold function seems to work very well, though I've probably forgotten some of the details by now. Still, I'd be happy to demonstrate it some time if you are interested.

**In conclusion, I would be very interested in either purchasing from you the stainless steel work necessary to construct the finished unit, or working in partnership with you to build one or more complete units.**

I should add that I think the Eifel area is particularly suited to this kind of innovation. The unit is very environment friendly, supplying natural heat and sunlight free of charge. There are many older houses in the Eifel with small north-facing windows, often sited in steep-sided valleys and built at a time when there was little or no planning for natural lighting issues. Such houses are often inhabited by more affluent owners now, who while unwilling to make large structural changes such as installing larger windows perhaps, might very well consider installing small sunlight reflectors. Ultimately, it might be possible to supply units with much the same off the shelf functionality as the present day satellite TV dish. The work is very garage/cottage industry based, with local sales and maintenance. It is very well suited to internet sales, communication, updates, maintenance, research & development, electronics, and online purchasing of parts and materials etc. It is also very visually impressive, making for excellent media reporting and advertising.

Finally, it would force me to learn more German! I had to use Google Translate to translate this, and I know some of the meanings have been lost or garbled – sorry about that. But I wanted to give you something in writing so that you had the time (and hopefully plenty of patience) to mull things over. Thanks,

Godfrey     [powellgodfrey@gmail.com](mailto:powellgodfrey@gmail.com)