Soft Energy Box

Beam 2023

About the Soft Energy Box

This box is the result of experimenting with devices generating energy. The question was if it is possible to get rid of the batteries powering e-textile swatches. Then if we, as humans, could power the e-textile swatches ourselves.

Yes! But it adds another layer of complexity to the existing layers of complexity, being the fabric properties, the electronic properties and the microcontroller-programming properties of e-textile swatches.

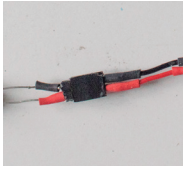
Energy - Urgent Question

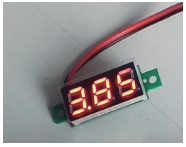
Even if energy is more expensive, we could still use these small batteries, since e-textile swatches are experiments. On the other hand, being experiments we could argue that “any” saving of energy, also the tiny ones are important. Besides, though these coin cell batteries are small, the factory producing these batteries is big.

Hand cranks?

Have to be produced too, we are in an endless labyrinth of production, consumption and wasting materials...

On the front side: Publication Jacket (Beam, 2022) with hand crank (Beam 2023)





Connecting convention
for the connectors:
red = plus voltage
black = minus voltage or Ground or 0V

Please do mind this so called “polarity”, if connected the wrong way, most electronics will get damaged and not work properly or not at all anymore.

Sometimes, there is no red or black: then both ways of connecting are ok, and produce a different effect, like with the double LED.

The led’s are “protected” by a resistor. This is needed because LED’s run on 2-3V and the hand cranks provide more, and the blue handcrank especially, can produce a voltage which is too high.

The voltage measuring device is needed to track the charging of the hand cranks. It will only indicate a number if the voltage is higher than 2.5 Volts or so. Indicating nothing can also mean that it is wrongly connected - check the connecting convention

SOFT ENERGY

soft means energy in relation to the human body - what we could produce ourselves.
It means also: small amounts of enery, enough for swatches, but not enough for heating a room.

Some ways to generate energy:

Solar - soft means small solar pannels
Wind - soft refers to small “toy” wind turbines.
human - muscle energy

Solar cap - solar and wind
Energy Harvesting Workshop, E-textile Summercamp 2014, Poncé-sur-le-Loir, France. (Beam, photo Mika Satomi)

Wind and design
Kites & Energy, WdKA Elective, 2022 (Beam)
Combining design of a kite with an propellor and motor, generating small amounts of energy energy

Energy by the human body
Soft Smart Energy Textiles, WdKA Elective, 2023 (Beam)
Hand generated energy combined with interactive textiles

The Soft Energy Box

Parts

1. Handcrank blue, transparent
2. Hand crank yellow, small
3. hand crank with solar cell

4. Super capacitor 1F
5. Super capacitor 2F
6. circuit with microcontroller and 3 led's

7. voltage regulator 5V
8. voltage regulator 3V
9. voltage regulator USB - 5V

10. led plus resistor
11. double led plus resistor

12. connector male male
13. connector female female
14. connector with aligator clips
15. double alligator connector

16. voltage measuring device

17. soft button e-textile swatch
18. UV e-textile swatch

These parts are selected for the experiments described. All parts have there "special" goal and functions to illustrate some properties of "soft energy".

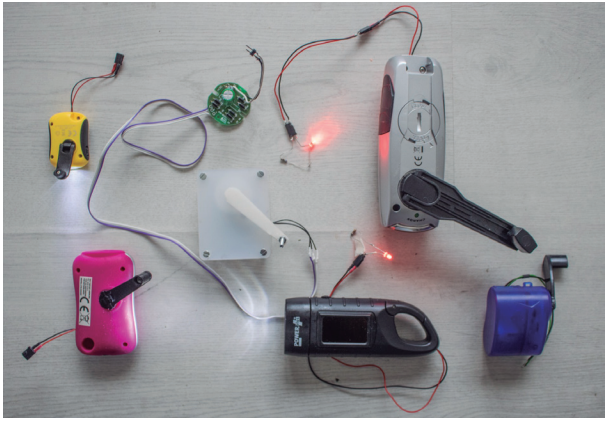
Work table with hand cranks, solar cells, super caps, e-textiles swatches without batteries, energy harvesters. (Beam, 2022)

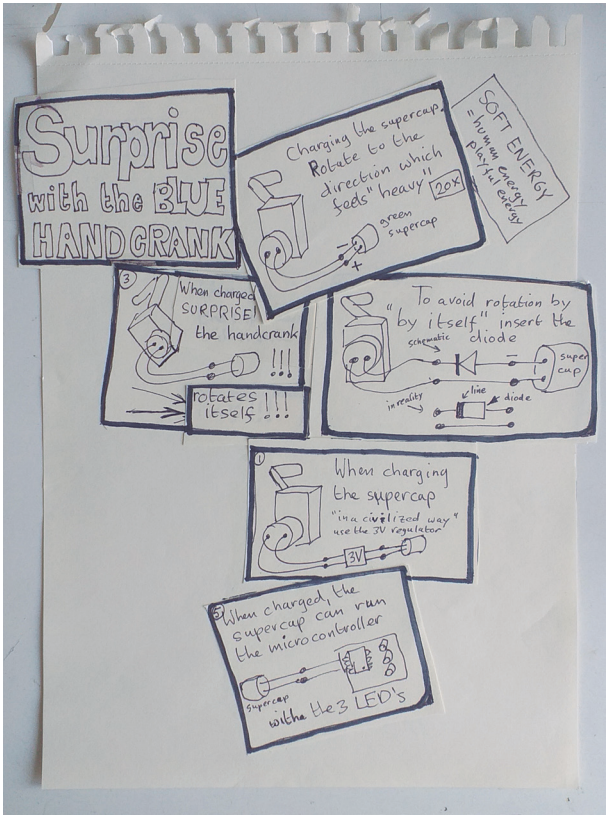
Hand cranks in the Soft Energy Box

The hand cranks are the main source of energy in the Soft Energy Box.

The advantages of a hand crank are:
you can generate energy yourself, not dependent on any other energy company or the Sun or wind or whatever source of energy. The toy versions generate enough energy for e-textile swatches and smal energy circuits. You can easily discover how the generator works. The energy is relatively small, so there is not too much danger.

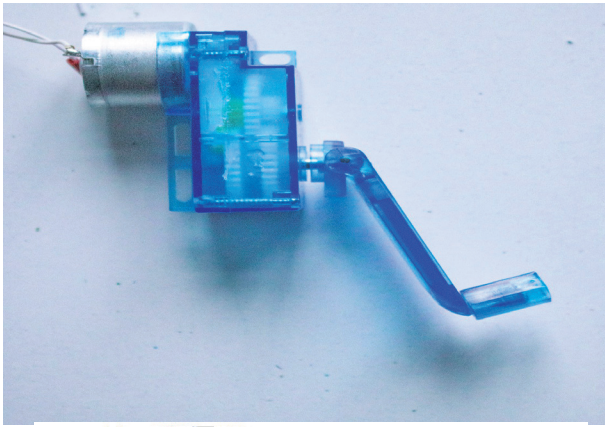
The disadvantage of these hand cranks are:
it takes a lot of effort to crank for a longer time.
your hand is not especially fit for cranking longer times, like your legs for instance on a bicycle.
the lipo battery inside is small and will be empty quite fast, depending on how much energy you use.

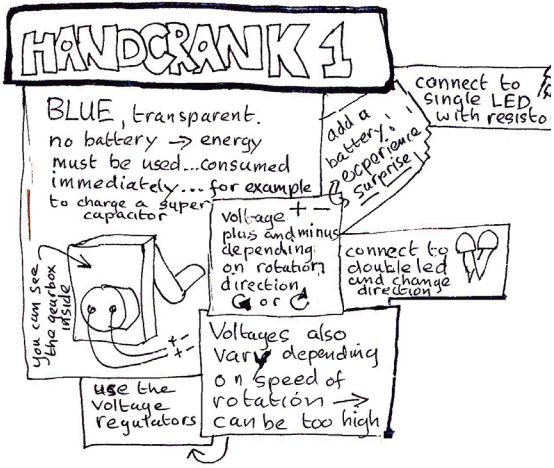




Fun experiments are described in the Quick Start Guide

Hand crank 1 - blue





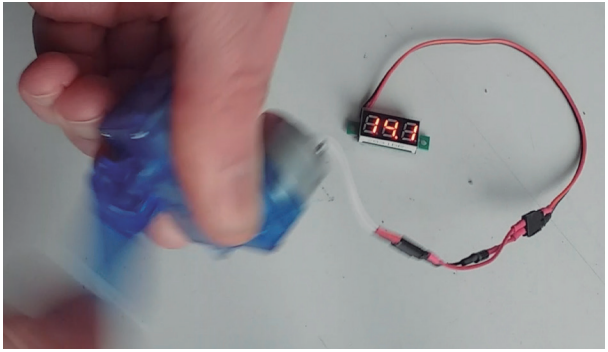
1. Transparent blue hand crank

1. Does not contain a battery
2. Visible gearbox
3. Producing 3V-9V or more, depending on speed of rotation
4. Because there are two directions of rotation, the plus and the minus can be reversed

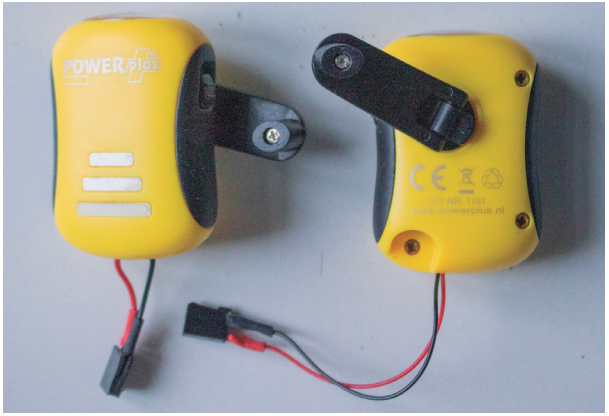
The plus and the minus can be reversed by rotating to the other side, so there is no “red” and “black” connector!

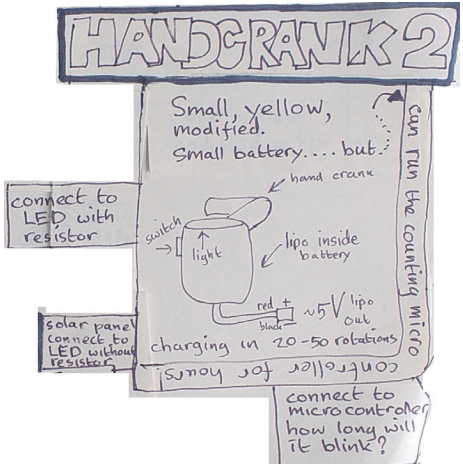
There is a rotation indication arrow - rotating in this way will produce plus voltage at the connection with the

A fun experiment is to connect the voltage measurement device and to observe how the voltage coming out depends on the speed of rotation: (This should be done with the “plus” connected in the right way to the voltage regulator!)



Hand crank 2 - yellow





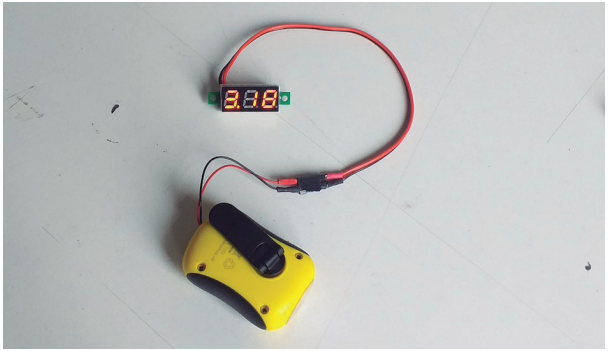
2. Small yellow hand crank

1. Does contain a small lipo battery
2. The voltage in the special wire is coming from the battery, so there is a definite plus and minus.
3. The voltage produced is between 3.8 and 4.2V

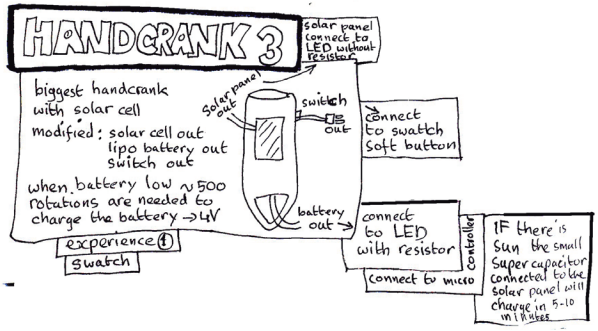
The plus and the minus can not be reversed by rotating to the other side, so there is no “red” and “black” connector!

Experiment: connect the voltage measurement device and observe how the voltage coming out does not depend on the speed of rotation. The voltage will stay the same after stopping the rotation, because this crank has a battery inside.

Check the number of rotation needed to charge the battery to around 4Volts with the voltage measuring device.



Hand crank 3 - jungle green



3. The bigger hand crank with solar cell

1. Does contain a small lip battery
2. The voltage is coming from the battery, so there is a definite plus and minus.
3. The voltage produced is between 3.8 and 4.2V
4. Bigger lips battery than the small yellow hand crank
5. The rotating feels heavier than the small yellow hand crank
6. The lipo battery will also be charged when placed in the Sun.
7. The solar cell can be connected seperately, also producing energy.

The plus and the minus can not be reversed by rotating to the other side, so there is no “red” and “black” connector!

Hand Crank with solar cell.

This hand crank is modified in three ways, getting out the voltage from the battery, getting out the voltage from the solar cell, and getting out the switch for the hand crank LED-light.

Charging

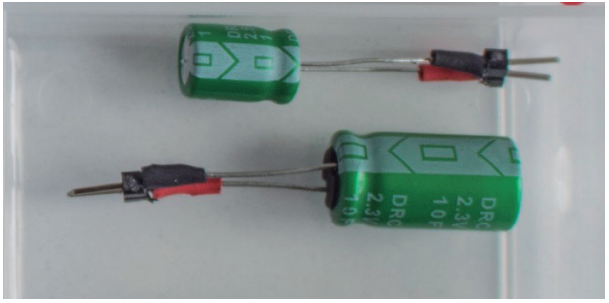
From “0” Volt, that is when the battery does not show any indication on the voltage measuring device, it takes about 500 rotations, that is about 5 minutes of rotating the crank to get the charge of the battery up to around 4 Volts, which can be checked with the voltage measuring device.

Super capitors in the Soft Energy Box

In the soft energy box one can find 2 Super capacitors with a capacity of 1F and 2F, serving as batteries for a few minutes. The 2F capacitor is a bit the limit of what can be charged with the blue hand crank.

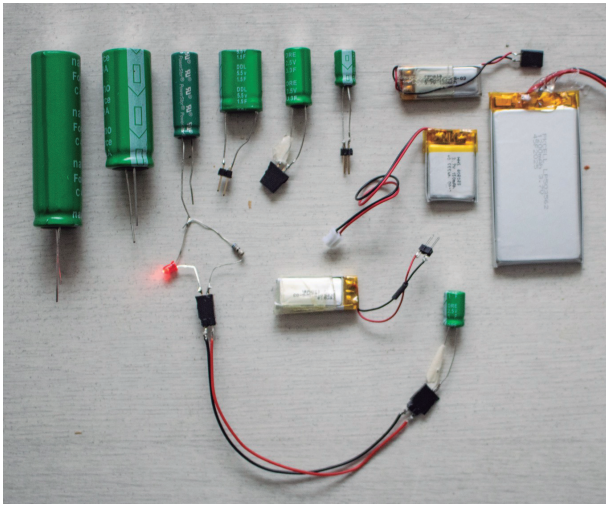
Every device storing energy has a “resistance”. When the resistance is too large for the charging device, it becomes hard to charge the battery.

Lipo batteries have in general a much larger capacity compared to the super caps, so these batteries cannot be charged with the blue hand crank.



Two super caps contained in the Soft Energy Box

In general: lipo batteries - supercaps



Supercap (green) and Lipo (silver) collection, Beam 2022
Only the smallest supercaps can be charged with the hand cranks. Nothing of these can be charged by a potato or aluminum cell.

Why do we use batteries, if we can use solar cells, potatoes, wind generators, or our muscles?

Batteries can store very much energy compared to potato’s, aluminum cells....

Experimenting:

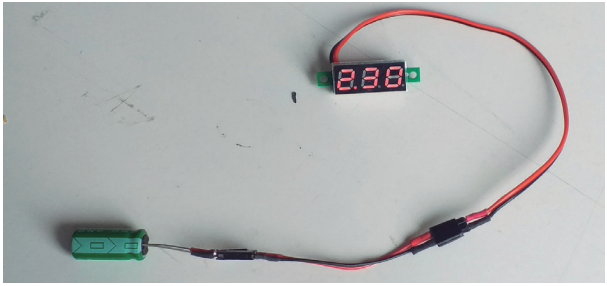
Using the Super capacitors

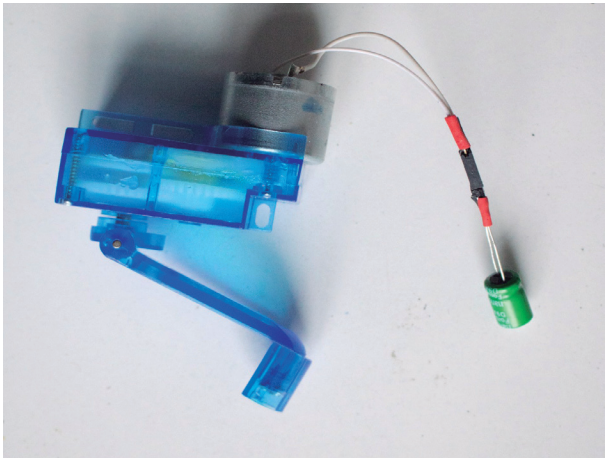
The blue hand crank can be used to charge a super capacitor. Rotating (in the charging direction) will require quite a lot of effort. After about twenty rotations the supercap of 1F is charged. Then this supercap can be connected to a LED or the circuit with the microcontroller. The LED or the circuit can be powered for several minutes.

A strange effect can be noticed after charging if the supercap is still connected:
The hand crank will rotate independently!
What happens is that the energy of the supercap is now flowing back into the generator and will start rotating the crank.

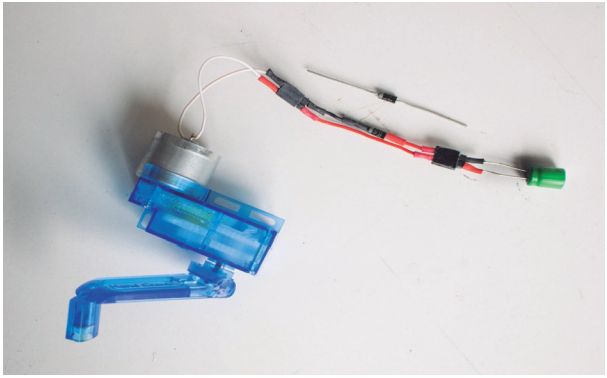
This flowing back of energy can be stopped by using a diode, which can also be found in the energy box.

Use the voltage measuring device to see if the supercap is charged - it can get up to 3 Volt, charging more will damage the supercap.

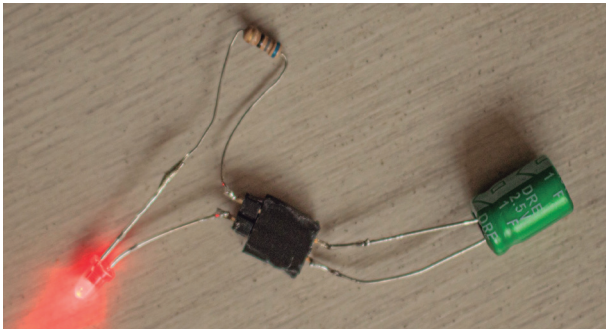




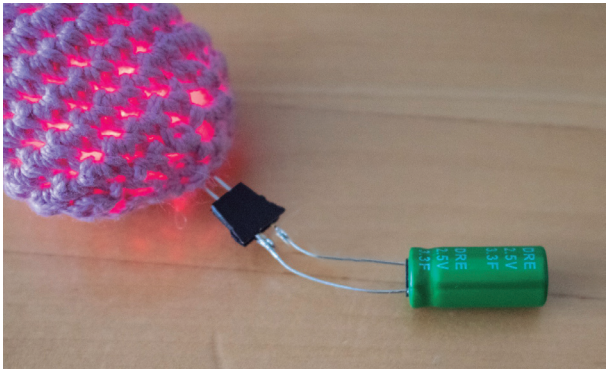
Above: charging a supercap.
Below: Charging the supercap preventing the flowing back of energy with the diode.



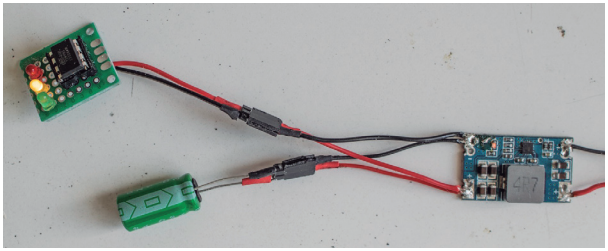
Powering stuff with the supercap

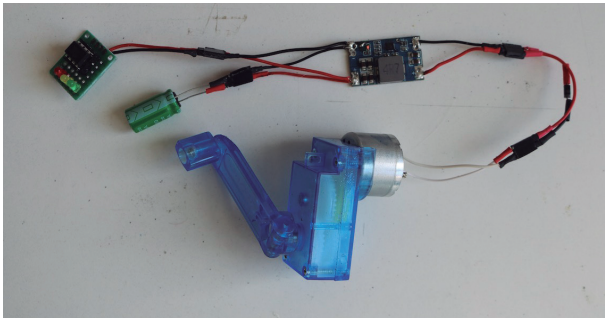


Running an LED on a super capacitor which was charged with a hand crank.



The same LED inside a knitted (crochet) sphere.



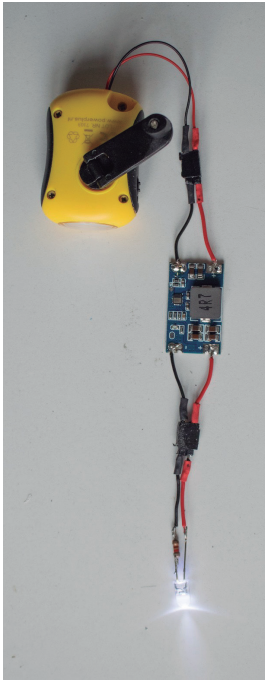


Running a circuit with an ATtiny85 microcontroller on a super capacitor which was charged with a hand crank.

The microcontroller is programmed to count seconds:
red led every second,
yellow LED every 5 seconds,
green LED every minute.

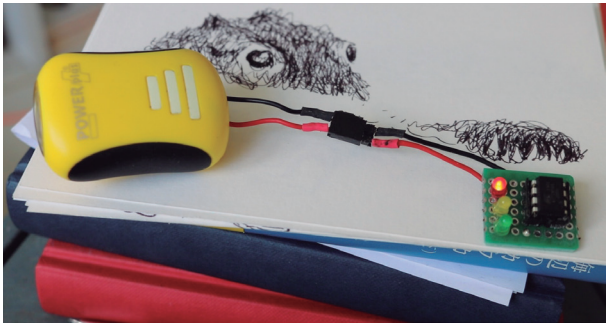
The script uses very energy efficient programming techniques.

Powering with the hand cranks



Running an LED on the lipo battery of the small hand crank hand crank. The circuit is running on 3V using the 3V regulater circuit (left).

When powering a microcontroller, the 3V regulator can also better be used, to protect the microcontroller and the devices powered by it.



Running a circuit with an ATtiny85 microcontroller on the lipo battery of the small hand crank hand crank. The circuit is running on 3V using the 3V regulater circuit.

Starting with a charged yellow hand crank the microcontroller, which is programmed with a very energy saving script, has been running for 3 days!

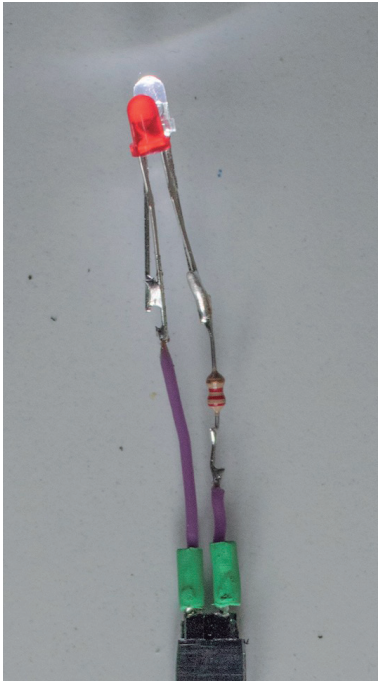
If you use an ordinary script, programmed in the Arduino environment, just using digital(pinNumber, HIGH) etcetera, the yellow hand crank will run for 5-10 minutes, while the bigger hand crank will power the microcontroller for 15 minutes or so.

Thus...programming everything so that as much energy is saved, maybe alone this could ave the world?

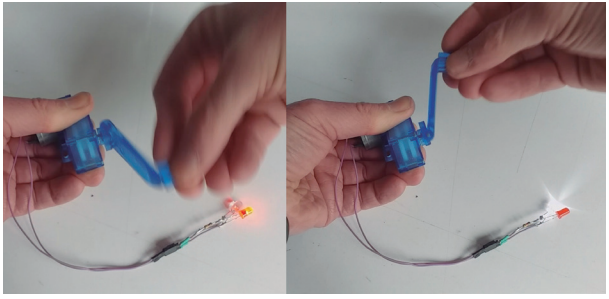
But surely, most energy is saved by just not using energy!

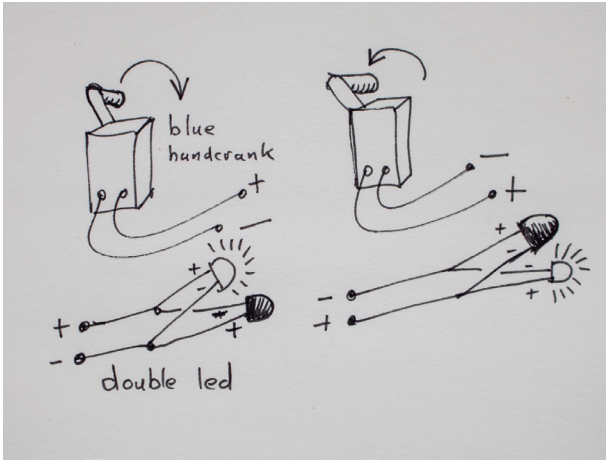
Note that no “real” Arduino Board have been used for the experiments in the Soft Energy Box: this board uses a lot of energy. The small microcontrollers, ATtiny85 and XIAO are much more efficient.

Using the blue handcrank and the double LED's



The double LED's are in a parallel setting, but the polarity of the LED's is reversed. This means that the direction of rotation of the blue hand crank will determine which LED is lighting up.





Running a circuit with an ATtiny85 microcontroller on the lipo battery of the small hand crank hand crank. The circuit can running on 3V using the 3V regulator circuit.

Comparing the two hand cranks using the microcontroller circuit

Running an LED on the lipo battery of the small yellow hand crank hand crank at the left, and at the bigger hand crank on the right. Since the box contains only one microcontroller, you have to do this experiment in two steps!

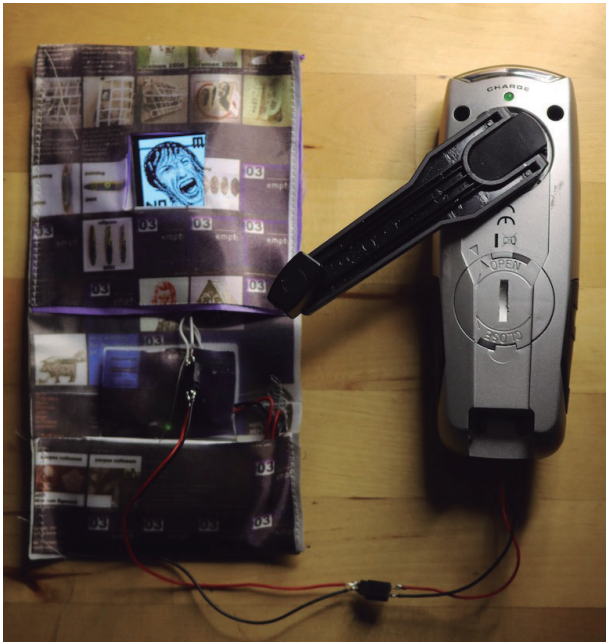
Compare the running times!

Which one of the handcrank can run the microcontroller the longest?

Discover the difference in battery capacity, between the hand cranks, or compare with the capacity of the Supercap's.

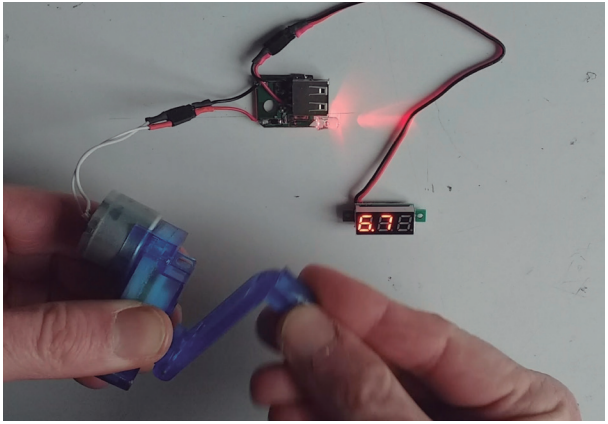
Powering other e-textile swatches

For example textile module with screen with a handcrank, The textile module has a microcontroller programmed to show pictures on an 128x128 screen, which askes for relatively much eenrgy, so it can only be sustained by the hand crank battery for a while.



This e-textile module is not included in this Soft Energy Box... Beam 2022.

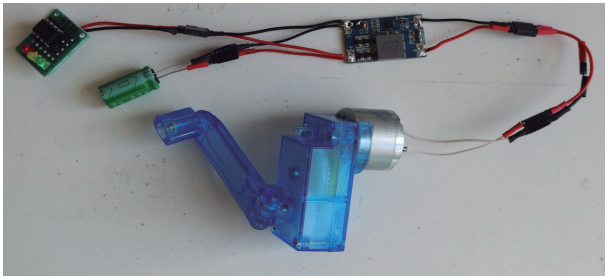
Using the USB charging possibility (?)



This USB connector was part of a so called “emergency hand crank”. These devices “could” potentially charge your smart phone a bit, to make an emergency call. The problem is that the smart phone has a big battery and this battery has therefore a high resistance. Even if you manage to turn the crank (when the smart phone is connected) tt will take hours of cranking before your smart phone has a bit of energy. But it might work!

As you can observe, the voltage is limited to around 5V, which will charge at 4.2 Volts when the load is added.

Using the 3Volt delimiter for a combination of the microcontroller and supercap.

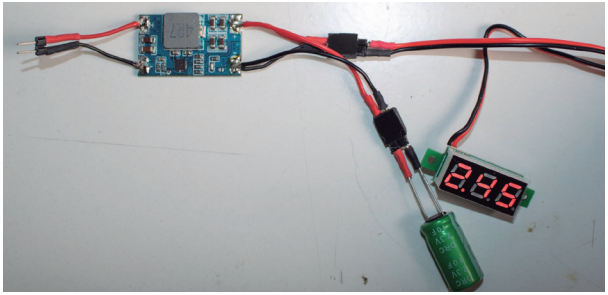


Connection for charging the supercapacitor, which will then run the microcontroller. Why is the diode in between?

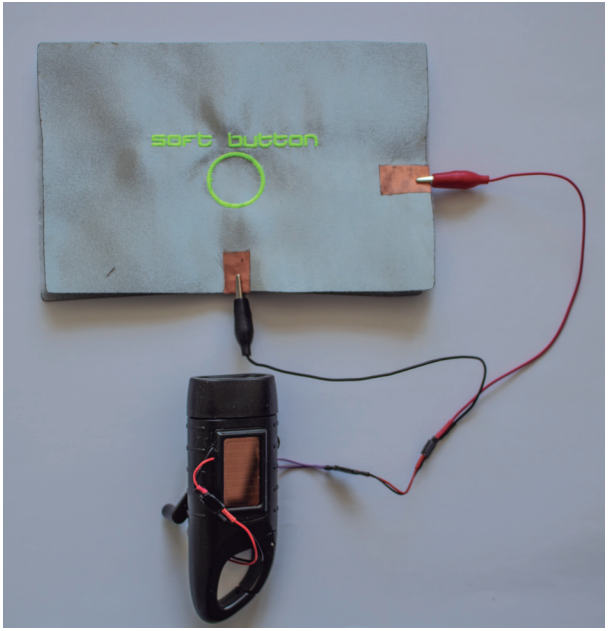
How long can the microcontroller run on the supercap?

The 3V Voltage regulator has two connectors at the output, the voltage measuring device can be connected to see the charging of the supercap.

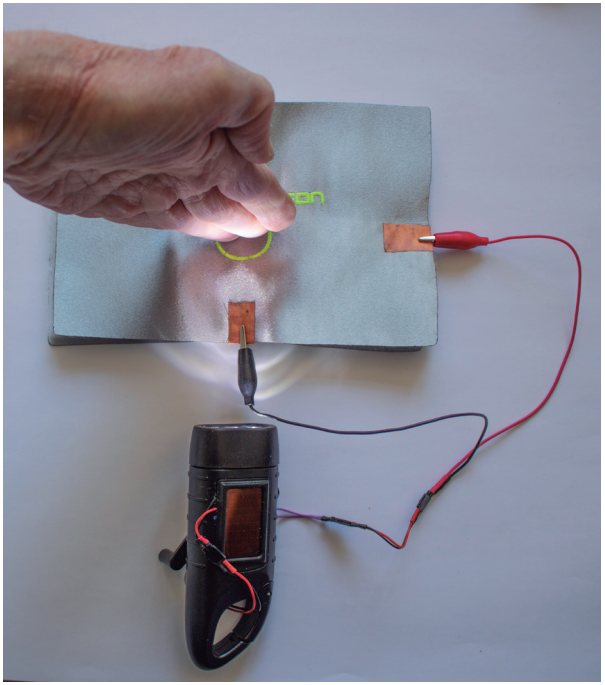
The supercap can only be charged with the blue hand crank!



Swatch 1: Soft Button

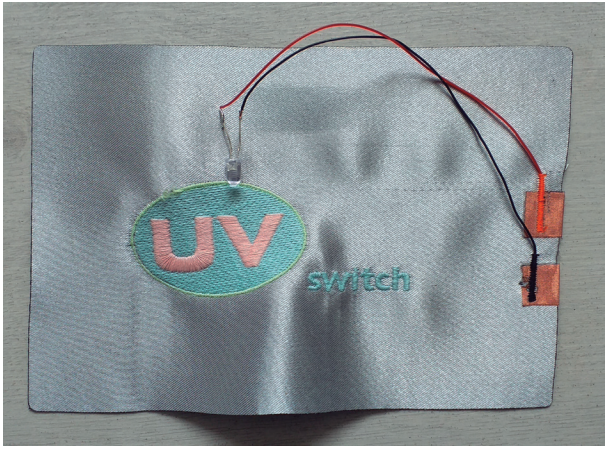


The soft button is one of the most basic e-textile swatches. Two layers of soft material containing conductive stripes are separated by a filling substance with a hole. If pushed the circuit is closed and the current can flow. Here the biggest handcrank from the box can be used to illustrate the function.



Use for this the connector to the switch at the side. The led's from the hand crank can be started with the soft button.

Swatch 2: UV led



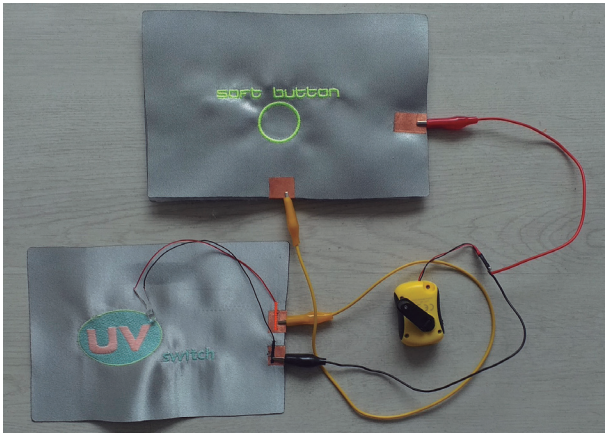
This swatch illustrates the second most used e-textile swatch, using an LED in combination with fabrics.

The ellipse is emboridered with UV yarn. Using an UV LED this yarn can “glow in the dark”.

The UV LED will energize the yarn, and then the yarn will glow a few second after the LED is off.

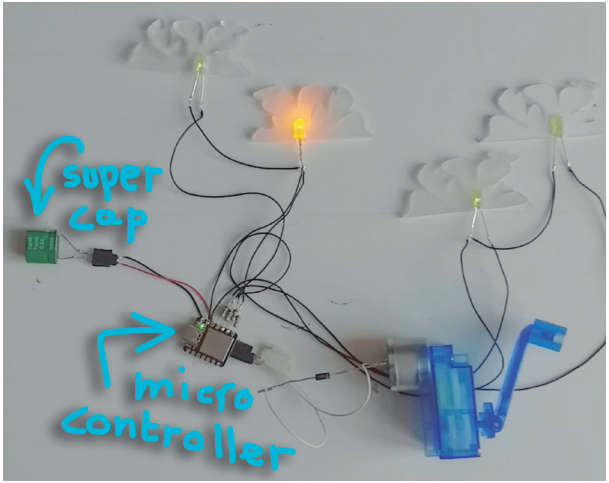
This way, you can even make a small drawing on the ellipse.

In combination with the soft button swatch, the led can be activated if the soft button swatch is pushed.



Be sure to connect the red of the handcrank, via the soft button to the red connector of the UV swatch, or the LED will not be activated.

Experiments and swatches



Experimenting

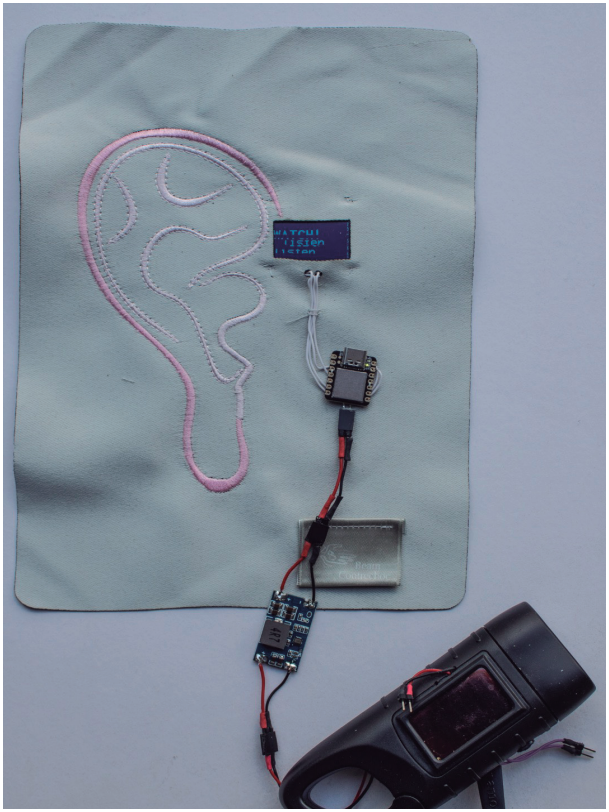
Microcontroller running on self generated energy, using a hand crank, “Clouds” not included in this Soft Energy Box...

This XIAO microcontroller can be programmed using the Arduino environment.

Energy from the handcrank is stored in the green supercap.

This energy is enough for a few minutes of action, which is enough to appreciate swatches.

Beam, 2022

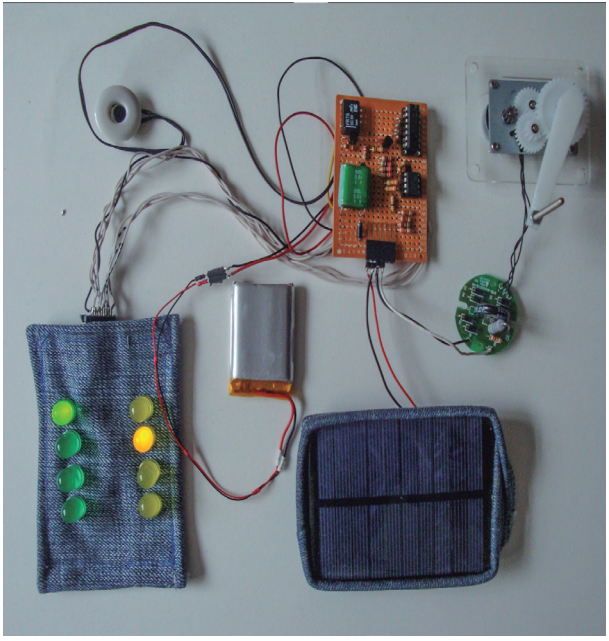


E-textile Swatch running on human energy! (about 20 minutes)
Embroidery, OLED screen with a XIAO microcontroller.

Beam, 2023

Un-fore-seen, Energy Exhibits for the WdKA, Beam 2023

Exhibits



Building up a game with a solar panel and a hand held generator, 2015, Beam

The two columns of led's indicate difference in progress.

The generator was hacked from the LJUSA handcrank. This principle was used in the dress shown at the right page.

Victory over the Sun, 2015, Beam Contrechoc.

Presented during the E-textile Summercamp, Poncé-sur-le-Loir, France. The garment is a game between "hand energy" and solar energy - who is the strongest?

This ensemble of 12 e-textile swatches was formerly running on adapters and is now running on hand cranks. This installation will be on show during Dutch Design Week 2023.
Although bigger hand crank are needed...than provided in the Soft Eergy box.
Beam 2023

Hand Crank Jacket, 2023, Beam

A jacket with a hand crank generator, powering a swatch on the jacket. Exhibit for Dutch Design Week 2023.

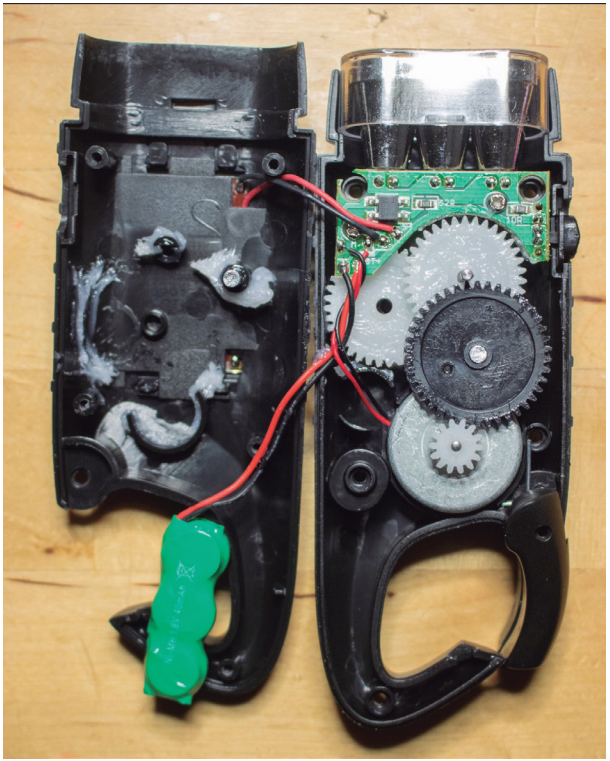
Opening up devices!

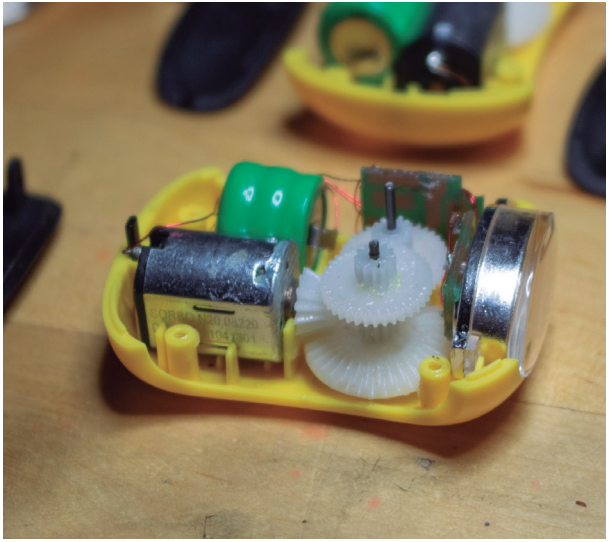
Although the hand crank and generators are toys, the gear box and the setup are carefully designed, a lot can be learnt by all the tricks used in the design.

Inside of an emergency hand crank for giving your phone just enough charge for one call, the gear box is plastic.
This hand crank is not included in this Soft Energy Box, it was broken or damaged too quickly.

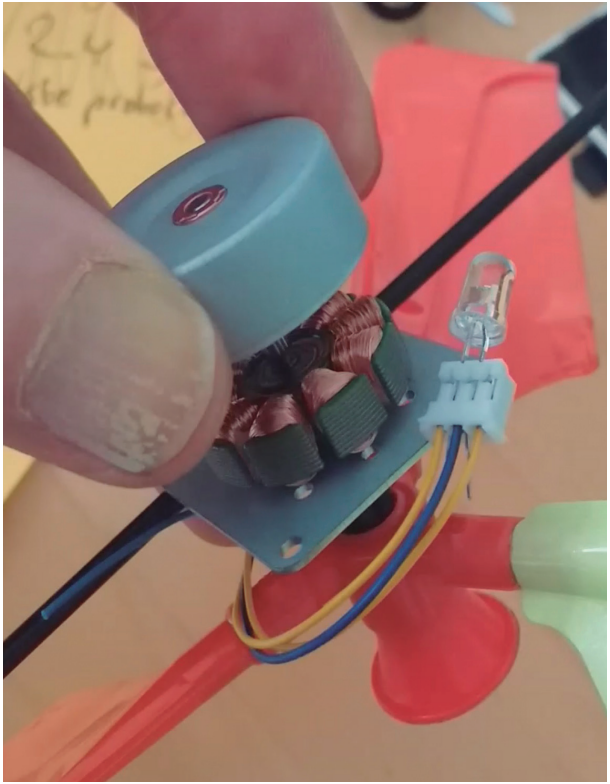
Inside of the bigger hand crank

Visible are the generator (circular object, middle right), the cog wheels of the gears and the rectifier diodes. The battery used in this handcrank is the green object at the bottom. The solar cell is at the invisible rear side at the left.





Inside the small yellow hand crank.
The gears, the motor, the battery (green), and the led's are all packed efficiently. Note the gear under an angle.



Inside of a Wind Energy Generator, showing the metal coils where the current is produced by the rotation magnets, as "induction".
Elective Kites&Energy, WdKA Rotterdam, 2022, Beam

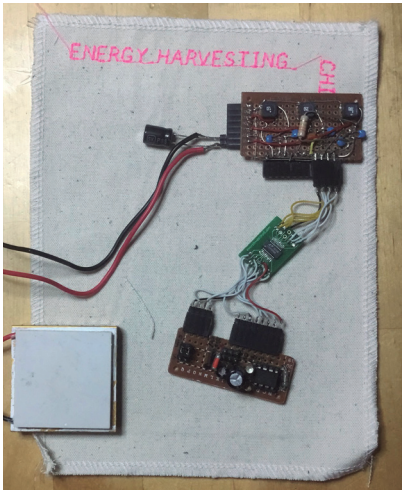
Experimenting Solar: Fountain on Sun Energy

Experiments, 2015, Beam
E-textile Summercamp, Poncé-sur-le-Loir, France.

Gesponsord
Seidon Fontein Op Zonne Energie - Geschikt voor...

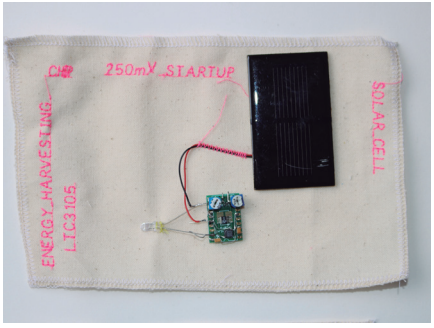
Nowadays, these fountains on solar cells are commercially produced and can be bought online. (Picture from Internet)

Related technology: energy harvesting chips



A swatch of the Portable Sensor Lab, 2018, Beam

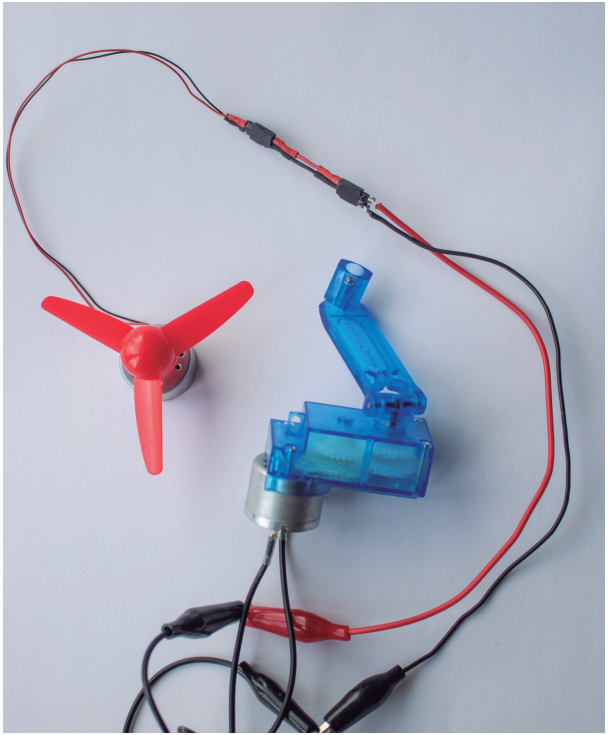
Body Energy - Energy harvesting chip ltc3108 in combination with a Peltier element. A hand is warm enough to light up an LED, connected to an ATtiny85 microcontroller



Solar - Energy harvesting chip on a swatch of the Portable Sensor Lab, 2018, Beam

The LTC3105 gathers energy and then starts lighting up the LED.

WIND generating Energy



Hand cranking a wind energy generator
Now the hand crank ***produces*** wind!

Elective Soft Smart Energy Textiles, WdKA Rotterdam, 2023,
Beam

WdKA Elective Kites&Energy: working small wind electricity generators on kites and flying the kites
Beam 2022
Introducing wind as an energy source for designers.
Going outside - Fieldlab - to collect energy.
Running to generate wind, needed to generate energy to power an LED.

Making your own propellor from a PET bottle.

About the Soft Energy Box

The Soft Energy Box is providing learning opportunities. It is not really for genereating “real” energy. “Real” energy is powerful, maybe dangerous, for real energy you need a specialized electrician.

This Soft Energy box is for being able to get an idea of how to generate energy, how difficult it is for a human being to generate the amount of energy we are used to in our current daily life. Are we “Energy Junkies” as an exhibition in the Nemo Museum was called?

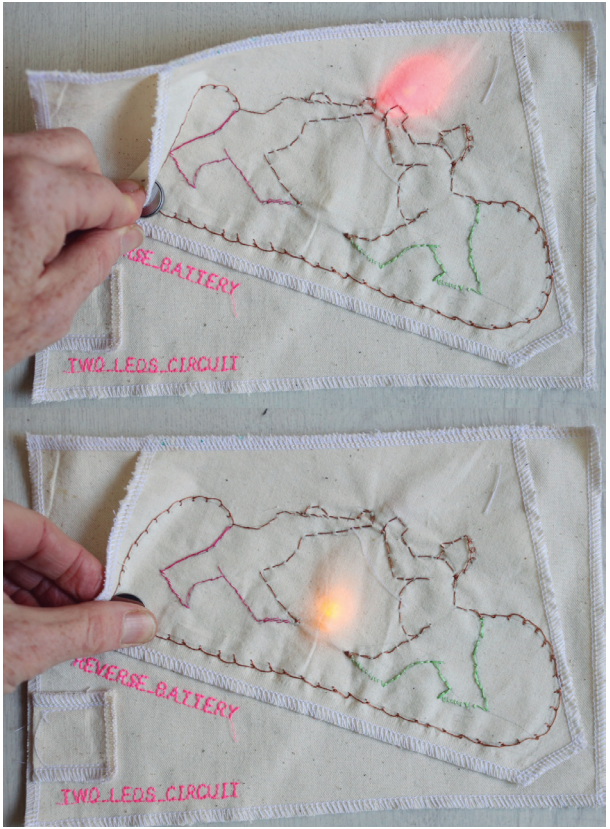
The experiment with the microcontroller in the box gives hope! Although the hand cranks were not able to provide enough energy for the bigger installation shown on page 42 of this booklet, even the small hand crank was able to power this microcontroller in the box for three days!

Also the bigger hand crank can power a swatch with an OLED for 20-30 minutes, even if the program wasn’t yet minimizing energy consumption.

We can program devices in a smart way, we can reduce the amount of energy we need enormously. The Earth can still be saved!

All swatches and exhibits and experiments in this booklet are by Beam Contrechoc.

Some were performed during the E-textile summercamp, organied by Mika Satomi in France, one in V2 Rotterdam, most swatches and the jackets were made in the Fashion tech Farm, EIndhoven.



Energy remains a challenge, or even a fight. If you win something at one point, you loose it at another. This swatch is was still powered by coin cell batteries... Beam, 2018

References

E-textile summercamp 2014 Energy Harvesting Workshop
http://etextile-summercamp.org/2014/energy-harvesting/
Beam Contrechoc, Becky, 2014
Workshop with solar panels and energy harvesting chips.

Ljusa hack:
https://interactionstation.wdka.hro.nl/wiki/Ljusa_hack
Beam Contrechoc, 2015
Using an existing device, getting the useful components out and use these for some energy design.

Portable sensor lab:
https://www.flickr.com/photos/contrechoc/albums/72157664460566867
Beam Contrechoc, from 2018 onwards
Huge collection of e-textile swatches.

¿Una batería portátil solar ahorra en la factura de la luz? Esto es lo que he aprendido durante un mes de uso
https://elpais.com/tecnologia/tu-tecnologia/2023-04-06/una-bateria-portatil-solar-ahorra-en-la-factura-de-la-luz-esto-es-lo-que-he-aprendido-durante-un-mes-de-uso.html
LAURA PAJUELO, ELPAIS, 06 ABR 2023
Very useful article where the author tries out a 1300 euro solar device and experiences that she saves about 3 euro each month on the electricity bill.

Elective Kites& Energy
https://interactionstation.wdka.hro.nl/wiki/Kites%26energy
Course of one week making a kite and constructing some device with a propeller - and flying the kites.

See for links: www.contrechoc.com/softenergybox.html

Wearing and powering an e-textile module - with e-textile outfit
Beam, 2023

This booklet is accompanying the Soft Energy Box
Beam, 2023

(unless otherwise stated, pictures Beam Contrechoc)

Beam with “do move” e-textile experiment and drawing, V2, Rotterdam, 2013