

Open Hardware

Introduction

Open Hardware (OH) or “Open Source Hardware (OSHW) is a term for tangible artifacts — machines, devices, or other physical things — whose design has been released to the public in such a way that anyone can make, modify, distribute, and use those things.”[1]

The general benefits of open source methods and open tech innovation are:

- Access to knowledge and product designs
- Fast and distributed exchange of skills and knowledge
- Accelerated innovation due to collaborative development
- Low development costs and more expertise
- Easy adaptation and customization

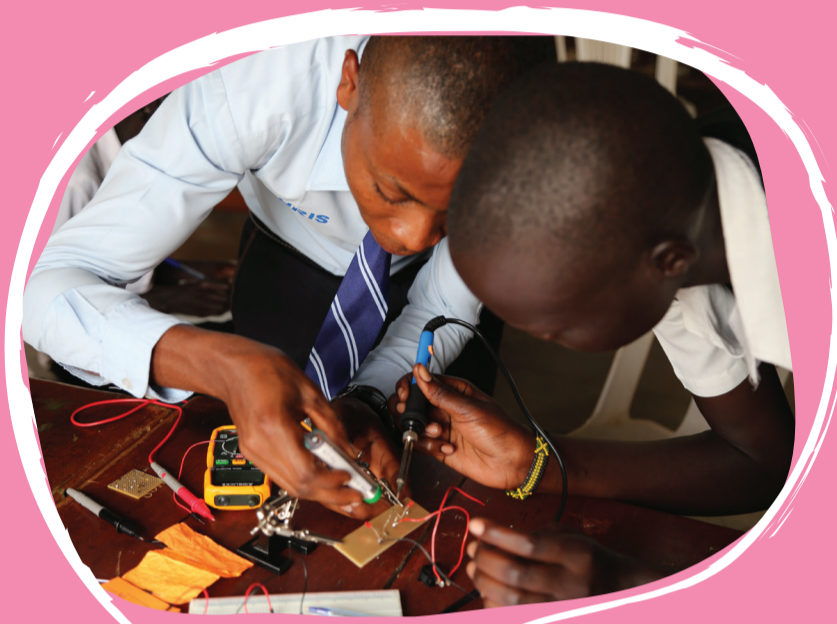
What do you need for Open Tech?

Tools & Materials:
Depends on the technology. Always try local sourcing first!

License Example:
A proper license for the product design.
For design-files, digital work: cc-by-sa Creative Commons License [2]
For hardware, functionality: CERN OHL (Open Hardware License) [3]

Open Source Software: Linux and platform independent if possible
Examples: see section Resources

- [1] www.oshwa.org/definition
- [2] www.creativecommons.org/licenses/by-sa/4.0/
- [3] www.ohwr.org/cernohl



Open Tech Skills

Training and Team

Experience Improvisations Motivational Skills
Creativity Basic Tool Skills
Knowledge Good Listening Hopeful
Time Management Skills Entertaining Passionate
Mission Commitment Social Skills
Hands-on Skills Explanation Skills
Technical Skills Approachability Visionable
Flexibility Word Skills

Open Tech Linux Software Installation

(on Ubuntu based OS)

Please run:
sudo apt update
sudo apt upgrade

```
sudo apt install gdebi software-properties-common libavcodec-extra ffmpeg  
redshift firefox libreoffice shutter vlc pinta pdfshuffler geogebra darktable gthumb  
trash-cli gimp inkscape openshot kazam audacity kdenlive freecad libreCAD  
fritzing kicad
```

Open Hardware Process - Documentation Principles

One key instrument of Open Hardware is clear documentation. In order to stay on track while developing or adapting a product, it is highly recommended to document the process to create an easy pattern to follow: Open Hardware Guide. This saves time and prototyping iterations.

Therefore good sketches and pictures of the steps are needed, that trace the development process clearly and simply in the order that it happens. The following template might help as you take important notes along the way:

Project: Name and Team	Date and Step/Workday
CC-BY-SA (digital) CERN OHL	Open Process Documentation
Steps: 1. 2. 3. ...	Tools: Materials: Tops: Open questions: <input type="checkbox"/> Mark as solved

Steps: Follow all working procedures & note the process step-by-step in the order it happens. Keep it clear and simple, note additional tips or details.

Flops & Tops: What went wrong and should be avoided? What went right and is noted as best practice?

Open Questions: What challenges, problems still need to be solved?(NB: This section is key to make progress and help others to participate in the process and get on board the project)

Open Process Documentation - Open Tech Guide

Using your Open Process Documentation (OPD) the next part is to create a clear and visualized Open Tech Guide for the current version. This Guide is key to empower further development and innovation.

Project: Name and Team	Date of release
CC-BY-SA (digital) CERN OHL	Open Hardware Guide
Steps: 1. 2. 3. ...	Tools: Materials: Tips and usage: Possible improvements: Open questions:

* References (weblinks, if available)

#ASKotek

Access to Skills and Knowledge - open tech emergency kit

Freely shareable and collaboration based Open Technologies are a form of Open Source that can also act as accelerators for peace and empowerment.

A versatile, robust and mobile trainer's kit with 40 items designed to tackle a range of basic education, innovation and self-training challenges #ASKotek enables 'Access to Skills & Development' in the field ... anywhere!

This basic Open Tech Kit provides tools and materials to learn and distribute knowledge and product development.

The set contains:

Basic electronics and connections
Soldering and cutting tools
Mechanical and measurement tools
A Linux computer and some adapters
Guidelines and additional things to get creative and start innovation on the spot

The kit can be used on site, in the field and can function as a startup tool-set for building a co-working space, learning hub or any other innovation community setup.

It is designed to be modular, mobile and adaptable to any location or situation to share knowledge and empower innovation.

#ASKotek was created by the participants of the Let's Go JHUB project.

The #ASKotek set contains:

- books (1 JHUB booklet, 1 solar book, 1 Open Learning Guide)
- 1 small trainers notepad
- 1 blue HP notebook (Linux Elementary OS installed)
- 1 clipboard with paper
- 1 protractor / square rule
- 1 pencil pouch (pen, pencil, ruler, cutter, 9V battery w/ wire connection, USB current meter, small Post-It Notes, highlighter, pencil sharpener, saw blades, small brush, 16GB USB memory stick)
- twine
- 1 pair of scissors
- 1 "helping hand" tool with magnifying glass
- 1 travel plug adapter
- 1 upgrade electronics kit
- 1 little electronics box (incl. solar charger pieces)
- 1 first aid kit incl. burn ointment
- 3 circuit boards
- 2 bread boards
- 4 x 4V solar panels
- 12V solar panel with adapter (in box)
- foam padding for PC
- small multimeter
- crocodile clips, jumper wires, twin wires
- 2 packets of 4 rechargeable AA batteries (2000 mAh)
- 3 x AA battery cases with switch
- 1 bag of switches
- 1 big multimeter
- 1 soldering kit (3 extra wires, 2 rolls of solder, 1 sucker, 1 solder iron + stand, 1 pack of extra tips, soldering grease and solder remover)
- 1 wire stripper
- 1 universal mobile phone repair tool set
- assorted heat shrink tubes
- 1 pack of 4 USB plugs
- 2 sizes zip ties (black - short, colour - long)
- 1 small hacksaw
- 1 pair chopsticks
- 1 mechanical tool set (Black and Decker)
- disposable cleaning pads
- 2 sizes of small zip-lock bags (150 and 380 ml)
- 1 LED light strip
- 1 ASKotek table of contents + packing / unpacking guide
- 1 small combination padlock (for locking case itself)
- 1 coloured combination chain lock (for locking case to something secure)
- 1 black dustproof / waterproof hard case 520 x 415 x 195 mm



Resources

OPEN TECH, OPEN HARDWARE + ELECTRONICS

MOZILLA WEB LITERACY

<https://learning.mozilla.org/en-US/web-literacy>
Web literacy 21st Century Skills: Problem-Solving, Communication, Creativity, Collaboration. Share, design, code, compose, remix, navigate, connect, open practice, contribute.

OPEN! METHODS & TOOLS FOR COMMUNITY-BASED PRODUCT DEVELOPMENT

opensource.design.cc
Current practices of open source product development & concrete guidance to support design process efficiency of open source product development projects.

OPEN SOURCE HARDWARE ASSOCIATION

<https://www.oshwa.org>
Open hardware community ensuring technological knowledge is accessible to everyone. Collaborative development of technology that serves education, environmental sustainability, and human welfare.

OPEN SOURCE EDUCATION

<https://opensource.com/education/13/4/guide-open-source-education>
A guide to free and open source education. Stories about creating, adopting, and sharing open source solutions.

AFRIMAKERS

<http://www.afrimakers.org>
Empowers makers in Africa to develop sustainable projects using rapid prototyping to solve local challenges.

APPROEDIA

http://www.appropedia.org/Welcome_to_Appropedia
Sharing knowledge to build rich, sustainable lives.

IFIXIT

<https://www.ifixit.com>
The free repair guide for everything, written by everyone.

INSTRUCTABLES

<http://www.instructables.com>
Share what you make with the world, and tap into an ever-growing community of creative experts. Participate in make-a-thons through the platform. Add your own instructables.

OPEN SOURCE ECOLOGY

<http://opensourceecology.org>
Open source industrial machines can be made for a fraction of commercial costs, designs shared online free, to create an open source economy which increases innovation by open collaboration.

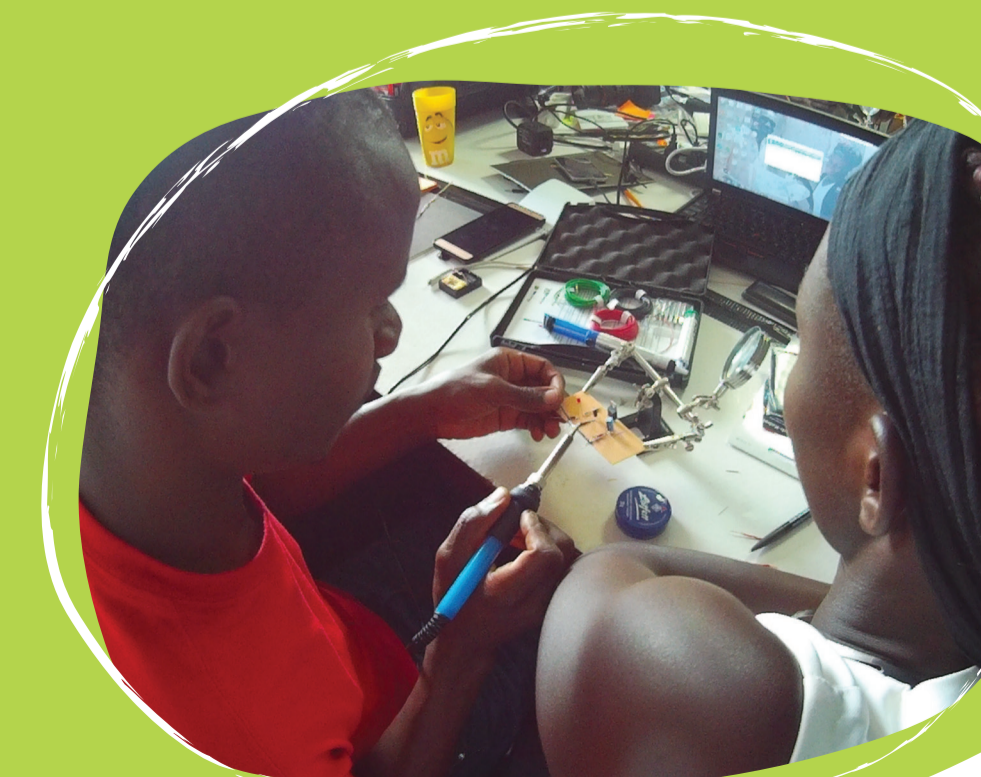
WIKIFAB

<http://wikifab.org>
Open source hardware documentation platform. Tutorials to make anything, written by everyone.

WIKI-HOW

<http://www.wikihow.com>
"We're trying to help everyone on the planet learn how to do anything. Join us."

NOTES:



Example #1

Phone Stand

CC-BY-SA (digital) CERN OHL (hardware)

Tools:

scissors
ruler
cutter
flat space
mobile phone

Materials

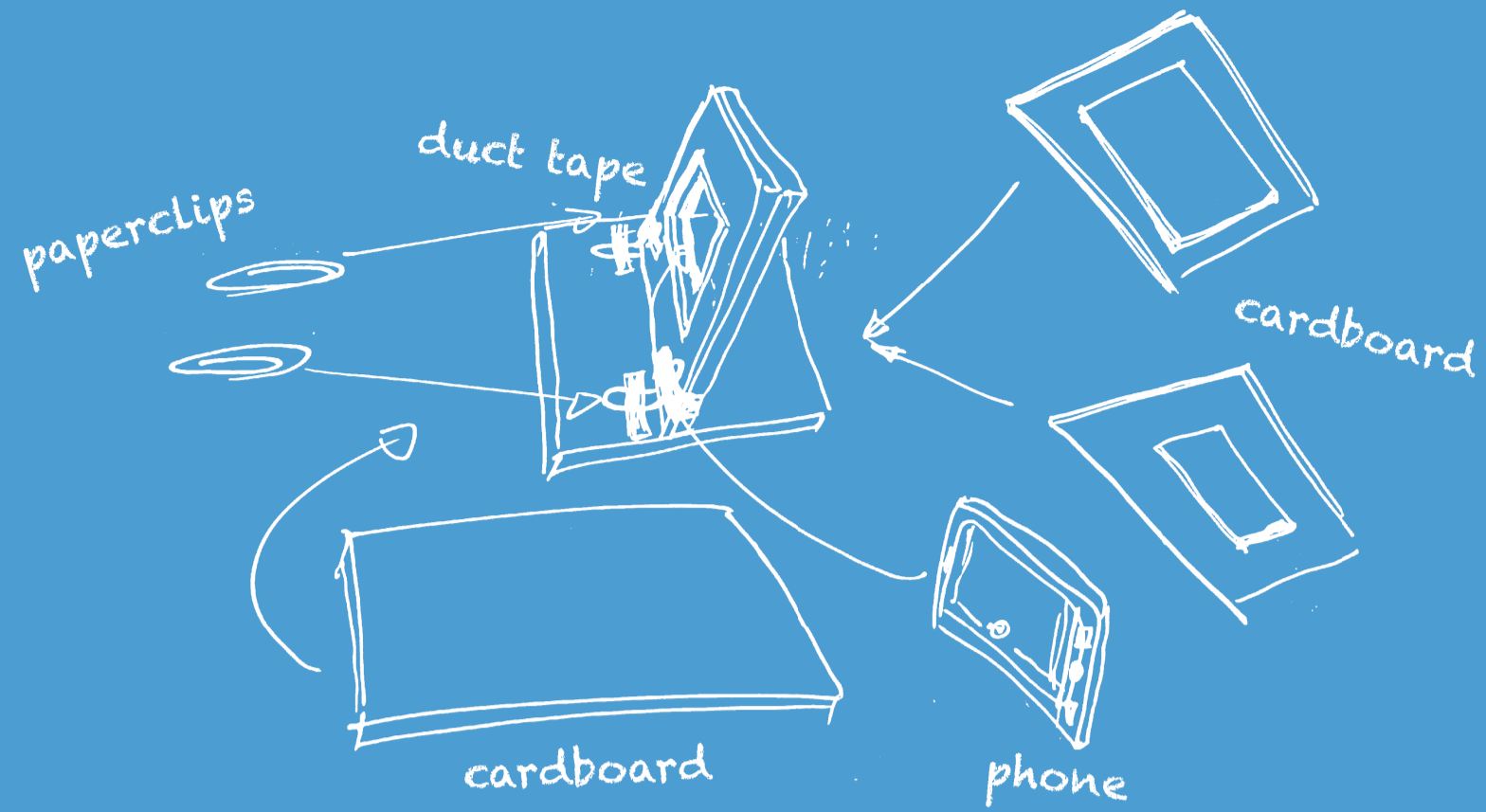
cardboards
liquid glue
paper clips
tape (optional)

Tips and Usage

- Keep away from water
- Portable, flexible and easy to maintain

Steps:

- 1 Preparation of working space
- 2 Get the cardboard and place on the table
- 3 Measure the length and thickness of the phone and choose outside measure
- 4 Start cutting the back of the phone holder
- 5 Measure the phone holder part if not done already and cut the phone stand.
- 6 Cut the side flaps and glue them together, depending on the phone size
- 7 Cover it with duct/gaffer tape (optional)



- 8 Insert the phone in the back of the phone holder
- 9 Join the top flap with stand using paper clips



Open for improvements

- Make some extra holes on phone holder in order to charge your phone directly.
- Make extra holes for the headsetmake holes to support the volume side

Open Questions:

- What other materials are possible?

Example #2

LED Light

CC-BY-SA (digital) CERN OHL (hardware)

Tools:

Breadboard (test circuit board) + wires
Helping hand (magnifier & clamps)
Multimeter
Soldering iron plus support
Soldering wire

Materials

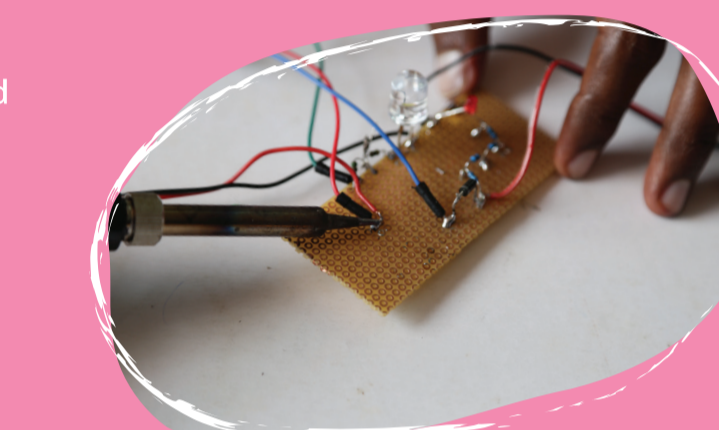
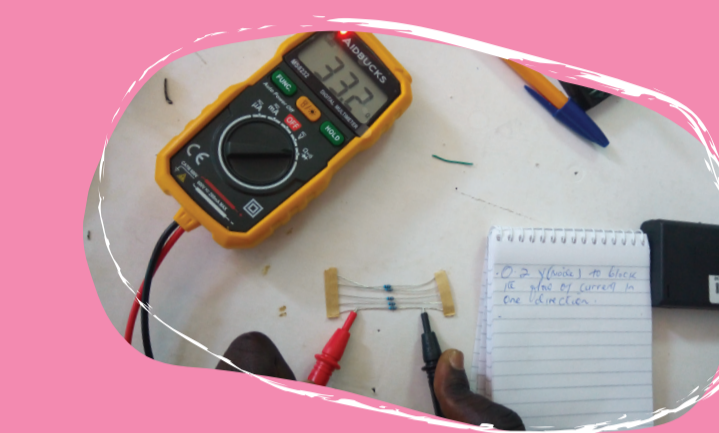
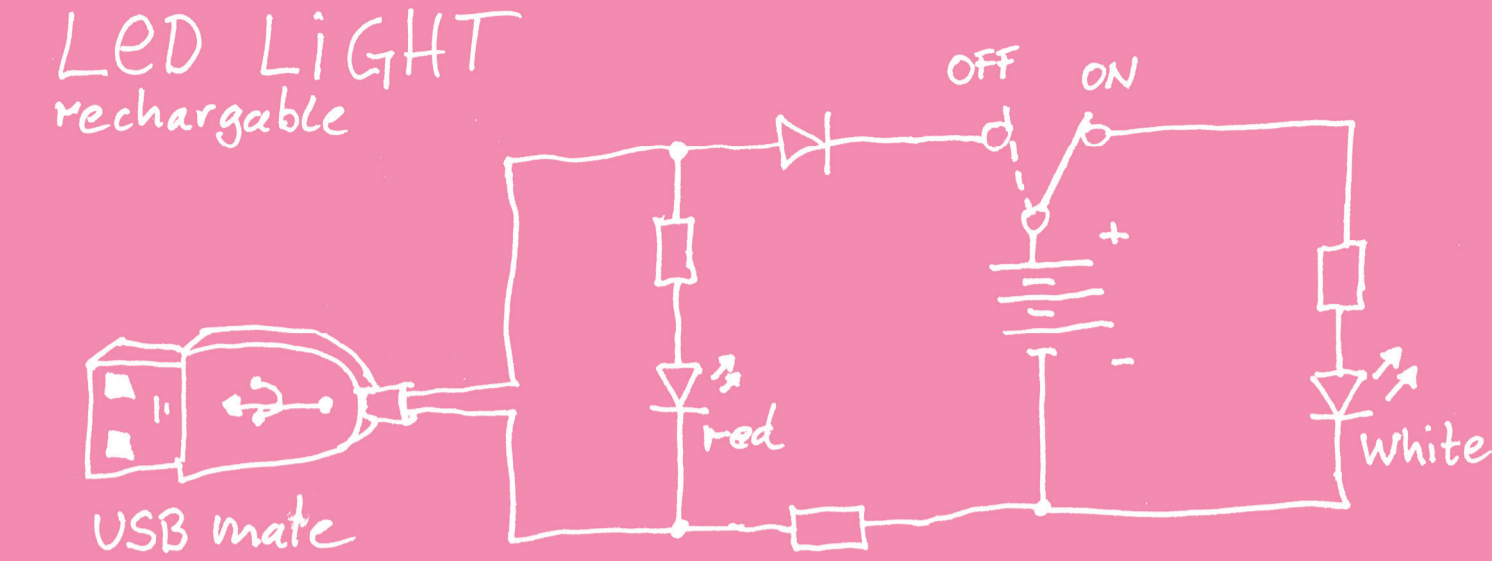
Resistors (600, 25, 10 Ohm)
USB (male)
Red LED 2V
Big white LED 3V
Switch
Diode

Steps:

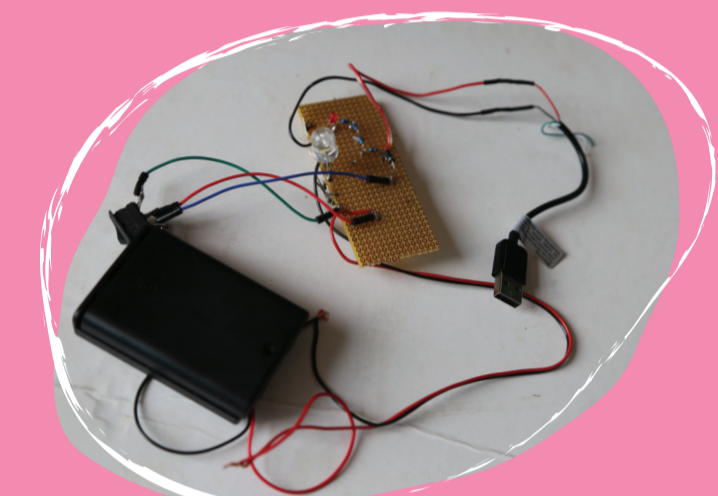
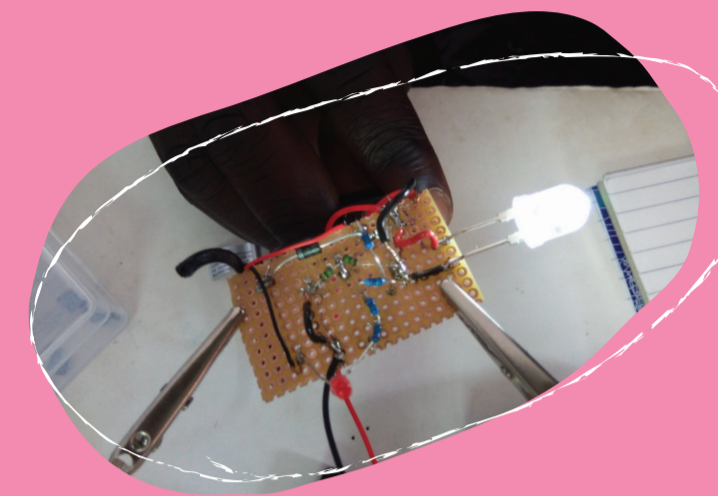
- 1 Measure battery voltage
- 2 Calculate and sort out resistors
- 3 Measure and cut circuit board
- 4 Identify the negative and positive lines
- 5 Start to solder the resistors (solder on board)

LED LIGHT rechargeable

USB mate



- 6 Solder the big LED lamp
- 7 Connect the batteries and LED to the switch
- 8 Solder charging red LED
- 9 Light up the big LED



Open for improvements

- Show red LED only when charging
- Build a casing

Open Questions:

- How to prevent the battery from discharging too much over time with simple electronics?

PARTNER INFO / CREDITS

PARTNER ORGANISATIONS

KAPITAL, an acronym standing for Knowledge - Afro-Invention - Peace - Information - Technology - Agrovetinary - Liberal Health is a Juba based grass-roots video, sound production, ICT and community training organisation. Running what it called a 'Virtual Academy' KAPITAL operated as an independent peer-to-peer collective of young designers, filmmakers, IT professionals and artists working to train each other in viable media oriented skills. Tapping the hopes, aspirations and dedication to create a new future beyond conflict KAPITAL established JHUB in late 2015, also initiating the first #peacehackcamp.

icebauhaus is the German partner in the international icehubs-network of green-tech & social innovation hubs, geared towards a bottom-up strategy that combines both local and international trends with state-of-the-art technological developments. icebauhaus' work is primarily project-based and community oriented. The members are experts in various academic disciplines, entrepreneurs and generalists with a great deal of background experience in international cooperation. Main expertise and experiences: ICT in agriculture [ICT4ag], experimental building & low-cost housing, techhubs, maker spaces and innovation networks.

r0g_agency for open culture and critical transformation gGmbH focuses on model social innovation and peacebuilding projects embedded primarily in communities experiencing post-conflict development. Its network aims to influence policy from the ground up, to inform and create more robust forms of civil society outcomes - bringing together arts, culture, open technologies and hands-on action for empowerment and skills training. r0g_agency's work taps into the power and breadth of contemporary free and public domain resources including open educational resources [OERs], free open source software [FOSS], open hardware, open data and open knowledge repositories.

Hive Colab started in 2010 as the first technology innovation and incubation space in Uganda, Hive Colab has a passion for solving the country's social and economic challenges, including introducing

more women to tech entrepreneurship. Hive Colab has worked with over 300 youths in economic empowerment through computer science training and human centered design idea generation. As a result, over 50 social tech businesses and enterprises have been created and supported.

Let's Go JHUB (#LGJ) is funded by the German Federal Ministry of Economic Cooperation and Development (BMZ) through its programme of "Support for Media, Access to Information and Freedom of Expression". JHUB and the project partner organisations are members of the Global Innovation Gathering (GI0), a network which hosted the "Let's Go JHUB" workshops and activities in neighbouring countries in 2016.

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This Open Hardware Guide is an outcome of the "Let's Go JHUB" workshops in open technologies hosted by Hive Colab in Kampala and the Panyadolli Self-Help Secondary School in Bweyale, Uganda in November 2016. It is intended to act as an example of hands-on skills possibilities in open hardware methodologies, acting as a introduction to resources and as a tangible tool for trainers, facilitators and anyone interested in exploring open technologies.

<http://jubahub.org> | <http://icebauhaus.com>
<http://openculture.agency> | <https://hivecolab.org>

#LGJ #openculture #ASKotek

Open Hardware Guide v.1
Hive Colab, Kampala November 2016
Design: Adam Ferns adamferns.com



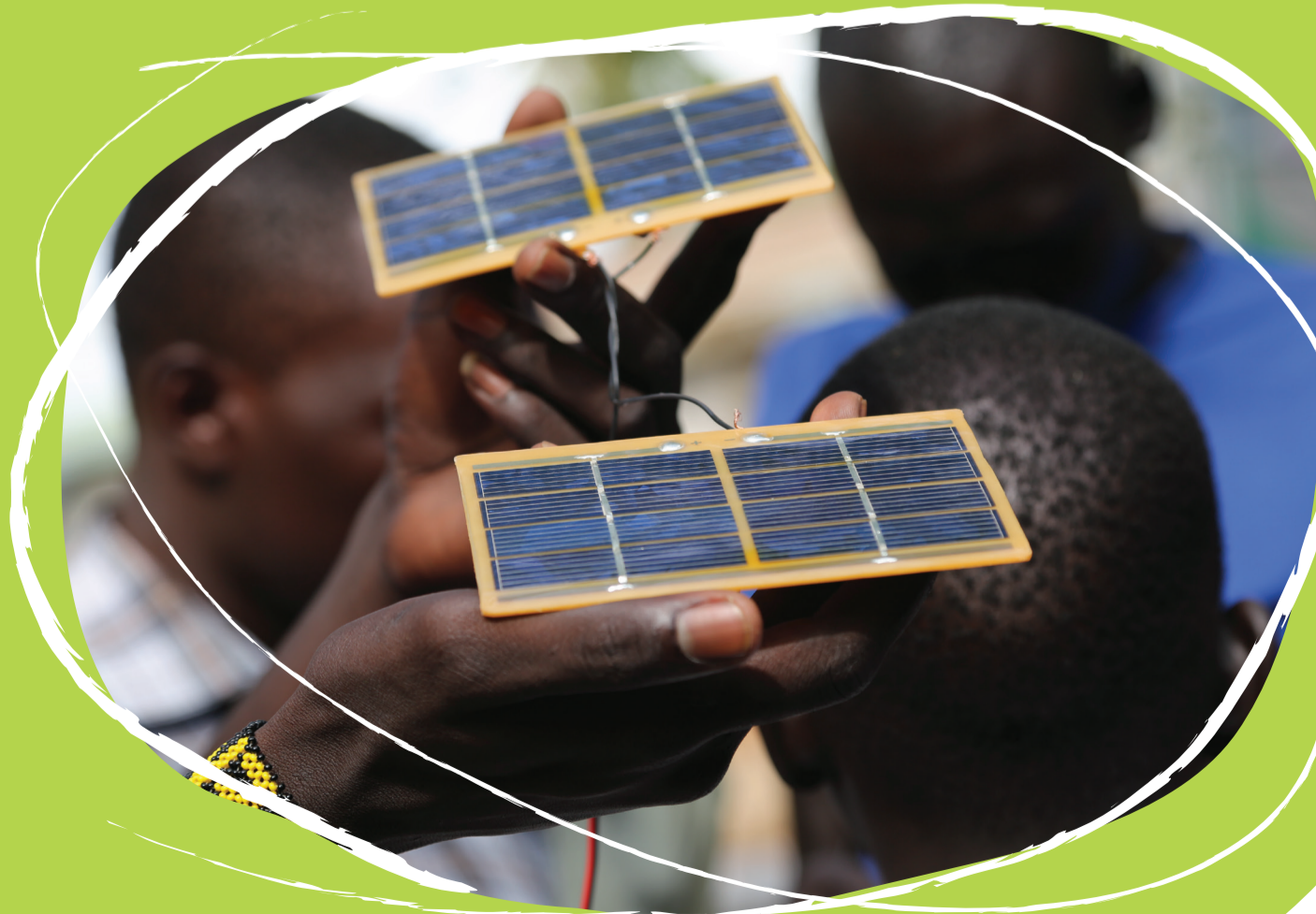
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JHUB

South Sudan's Open Knowledge and Innovation Hub

OPEN HARDWARE GUIDE

Pioneering Open Tech Innovation for South Sudan



Example #3

Solar Charger

CC-BY-SA (digital) CERN OHL (hardware)

Tools:

Color-coded wire (red and black)
Soldering iron
Soldering grease
Soldering Sucker
Helping hand (magnifier & clamps)
Soldering wires

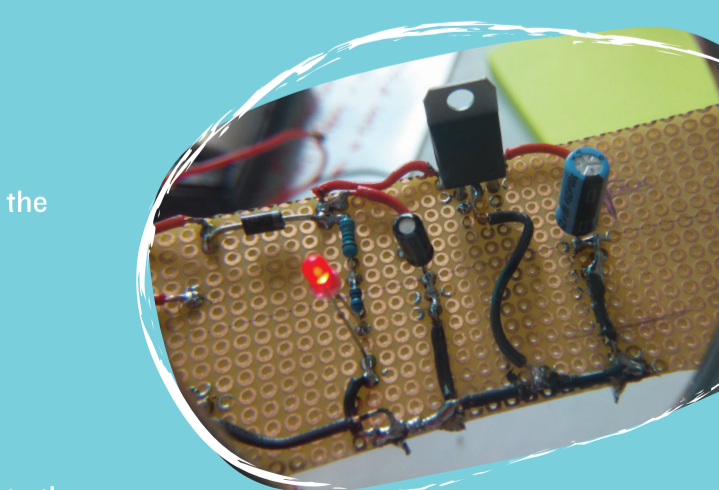
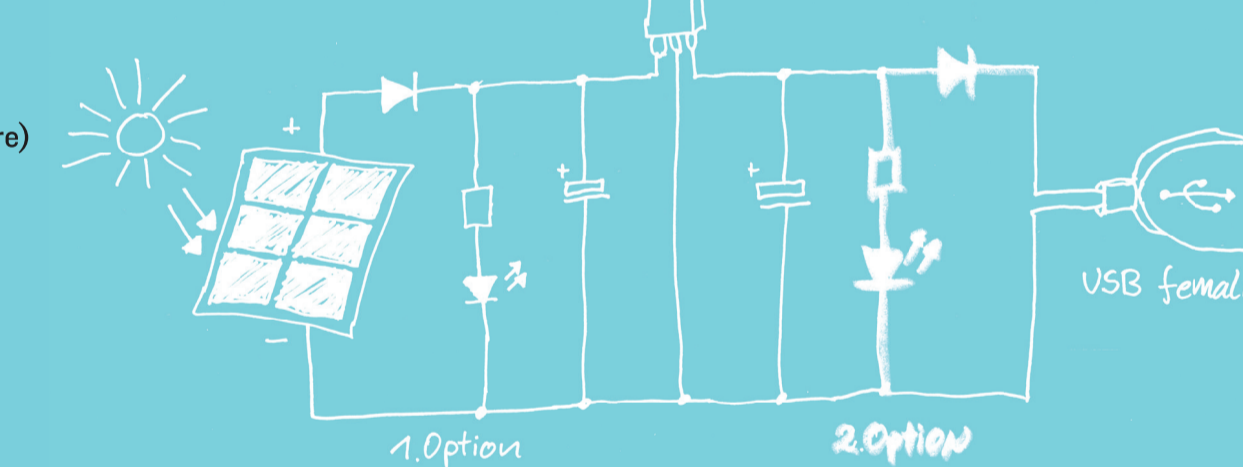
Materials

Solar panel 8V +/- 250mA
Resistor 1200 Ohm (1. option)
Resistor 600 Ohm (2. option)
1 Diode (for either Option 1 or Option 2, Option 2 is recommended)
Capacitor one 10 µF
Capacitor two 100 µF
Female USB
5V Regulator
Circuit board
LED light (red one)

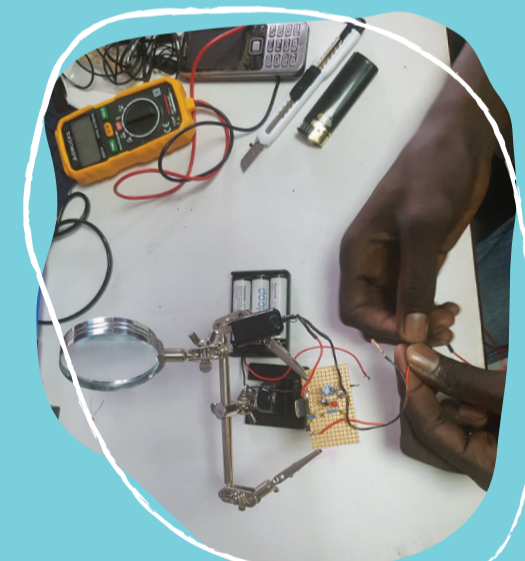
Steps:

- 1 Draw diagram of the charger for easy understanding (optional)
- 2 Open your ASKotek kit for tools
- 3 Get circuit board and solder the diode and LED in place
- 4 Solder the resistor in the front of the LED
- 5 Connect to the LED lights to the negative side

Solar CHARGER



- 6 Solder the capacitors with long side connected to the outer regulator legs
- 7 Fix regulator with black side facing you and connect between diode and resistor
- 8 Connect the other side of the regulator to the capacitor (long side connected)
- 9 Connect all the negatives sides together
- 10 Cross the middle pin to the negative with side to LED
- 11 Behind the diode (1. option) or to the right capacitor connect the positive wire from solar panel
- 12 And the other negative to the negative side
- 13 Connect female USB. Positive on red and negative on black
- 14 Test the Solar Charger in the sun



Open for improvements

- Build a casing

Open Questions:

- How to find + and - wires on female USB (if not red and black)?
- What if somebody is surrounded with no material, how to use old electronics?