

DIY Lab

Making outreach accessible



We wanted to make our educational program accessible and affordable. Building up on the progress made by the iGEM community in the past we have collected different DIY hardware projects. These include all devices needed for the outreach program to be possible at any setting. We have included the selection of DIY lab hardware consisting of DIY spectrometer, incubator, microscope and centrifuge from the teams Aachen 2018 (RWTH Aachen University, Germany) and ArtScienceBangalore 2010 (Srishti School of Art, Design and Technology, India) to our collection of educational materials. We hope the provided documents can enable more teams to implement educational outreach in their local communities.

The DIY materials included are:

- DIY spectrometer at pages 2–7
retrieved from <https://2018.igem.org/Team:Aachen/Hardware>
- DIY spectrometer at pages 8–22
retrieved from https://hackteria.org/wiki/index.php/DIY_handheld_centrifuge
- DIY spectrometer at pages 23–26
retrieved from https://hackteria.org/wiki/index.php/DIY_microscopy
- DIY spectrometer at pages 27–39
retrieved from http://hackteria.org/wiki/index.php/DIY_Incubator

We encourage you to visit original pages of the DIY projects listed above.

Construction Manual of Merlin spectrometer

The first generation of our Merlin Spectrometer is based on the ramanPi Spectrometer. The Project was developed open source with a detailed construction documentation. In the link below you will find some details.

<https://hackaday.io/project/1279-ramanpi-raman-spectrometer/log/9583-how-to-build-a-spectrometer>

In the working progress we optimized Merlin for our challenges, added some features for calibration, sample handling and other adjustments. In the following part list you will find everything you need for your very own Merlin spectrometer. Furthermore you need access to a 3D-printer to print your spectrometer casing and other components.

Quantity	Component	Cost [€]	Cost [\$]
Optics			
1	razors	4	4.60
1	ringt magnet 30mm diameter, 5mm depth, 5 mm hole	2	2.30
1	VIS holographic grating, 1200 grooves/mm, 25mm square	124.24	135.00
1	spherical mirror, 20mm diameter, 80mm focal length		37.50
1	concave mirror, 50 mm diameter, 100 mm focal length		42.50
Control Unit			
1	microcontroller NUCLEO-F401RE	11.49	13.21
1	capacitor 10µF, 25V SMD 1206	0.1	0.12
2	capacitor 0.1µF SMD 1206	0.2	0.23
2	resistor 150 Ω SMD 1206	0.2	0.23
1	resistor 2200 Ω SMD 1206	0.1	0.12
1	74HC04 SMD 1206	0.2	0.23
1	Toshiba Transistor 2SA1015-Y	0.1	0.12
1	USB A cable	2	2.3
1	PCB board	5	5.75
1	Toshiba TCD1304 Linear CCD		4.00
Wiring and Screws			
4	black M2.5 x 30	0.40	0.46
6	black M3 x 12	0.4	0.46
3	black M2.5 x 12	0.3	0.35
2	black M3 screws	0.2	0.23
6	jumper cables	0.6	0.69
Optional Graphic Interface			
1	Raspberry Pi	35	40.25
1	6inch LCD Screen	35	40.25
1	MicroSD card 8 gb	5	5.75
Total Cost			250.38
Cost with Graphic Interface			336.63

Step by step preparations and assembly

Attention!

The diffraction grating and the mirrors should be handled carefully. We recommend disposable gloves and hexagon socket screws to prevent scratches and fingerprints. Be careful when preparing the gap. When working with the shaving blades and the magnet you can easily cut yourself.

First step - download and get started with the 3D-prints

Download every print-file on our website for your own spectrometer and print Merlins spectrometer casing. After printing remove all unnecessary support structures and free every screw hole. Before all components are installed, it is recommended to put all screws into the housing. Furthermore you need to print the two mirror holders, the diffraction grating mount, and the frame for the CCD modul.

Second Step - fixing optical components to the corresponding holders

Fix the optical components to the corresponding sockets with double-sided adhesive tape. The fixation is secured with a little glue. The diffraction grating frame is secured in the lower area between the frame and the case with a round thin latex strip. The rubber ring is removed from a disposable glove and ensures the security and rotation for later calibration.

Third Step - Prepare slit or small hole

For a narrow gap, two razor blades (7mm * 15mm) are cut out of a razor blade with scissors covering the hole of the magnet to create a fine gap with the desired gap width. The gap is fixed with scotch film without sticking over the gap. For a small square hole, work is done equivalently with four cut razor blades. Optimize the gap width for your requirements and note that as the gap size decreases, the spectral resolution increases and the intensity decreases.

Fourth step - CCD modul

Complete the TCD1304 Linear CCD module following the instructions of Esben Rossel. His detailed instructions can be found in the following link: <https://hackaday.io/tvaettbjoern>

We used a Otter T1304 PCB board, which has the same port constellation as Esben Rossel's second SMD-Version. For the PCB board you will need resistors, capacitors, ports; IC, Transistors with following specifications (table 1). To make the depths of the CCD sensor adjustable, we inserted two layers of the socket strips. We recommend to provide the six jumper cables with markings for the connections.

Table1 specifications for the CCD modul

R1; R2	150Ω SMD 1206
R3	2,2 kΩ SMD 1206
C1; C3	0,1 μF SMD 1206
C2	10 μF SMD 1206
T1	2SA1015-Y
IC1	TC74HC04 SMD 1206
CCD	TCD1304
Socket strips1 (ST1)	4x 11 Female headers BLY 1
Socket strips2 (ST2)	2x 5 Female headers BLY 1
PCB board	The Otter TCD1304 board
6 jumper cables	

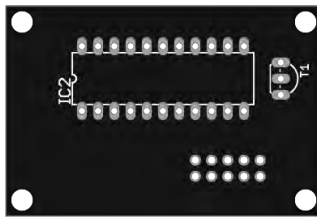


Figure1: Interior view of the PCB board within Merlin on which the ccd sensor is placed on a two-layer socket strips1 (ST1).

In the link below you can find more details about the PCB board:

<http://dirtypcbs.com/store/details/863/the-otter-tcd1304-board>

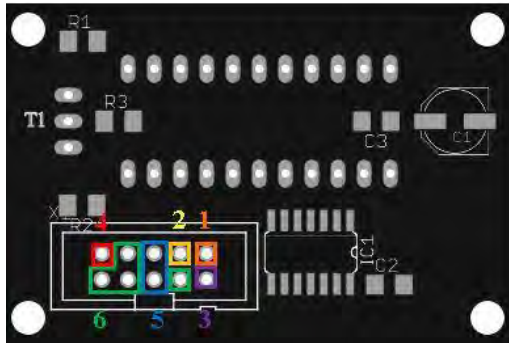


Table2 How to connect the CCD modul with the nucleo

1 fM	connects to	PB0 (A3)
2 SH	connects to	PA1 (A1)
3 ICG	connects to	PA0 (A0)
4 OUTPUT (OS)	connects to	PC0 (A5)
5 +5V	connects to	+5V
6 GND	connects to	GND

Figure 2: The corresponding external view of the PCB board within Merlin to which the IC1, C1, C2, C3, R1, R2, R3, T1 and the socket strips2 (ST2) are soldered.

Fifth step - final assembly

Upon completion of all preparations, all items can now be located at their intended location in the lower part of the spectrometer housing, as shown in figure 3.

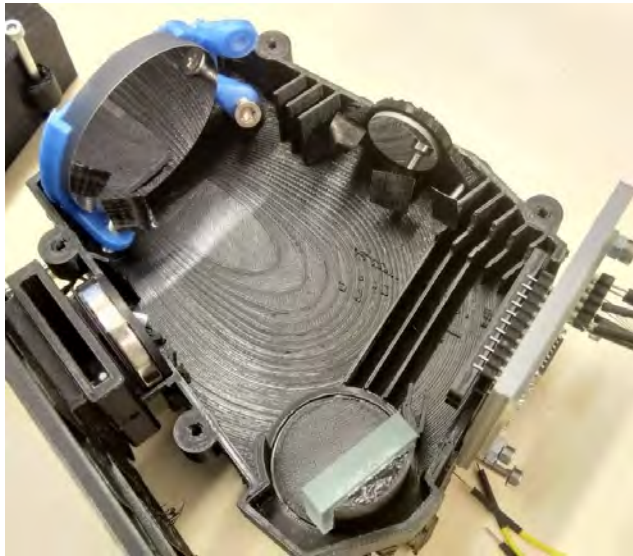


Figure 3: lower half of the Merlin spectrometer with built-in components.

Sixth step - calibration

For coarse calibration, a laser with a defined wavelength is recommended. We used a laser with a wavelength of 650 nm and a power of 0.4 mW, which represents only a low risk for the eyesight. When calibrating with the slit and the above-mentioned laser, it is urgent for a good spectral resolution that the distance from the slit opening to the first small spherical mirror correspond exactly to the focal length of 8 cm so that the reflected light beam is collimated to the diffraction grating. The distance between the large concave mirror and CCD sensor must also be adjusted with great care to the focal length of 10 cm. After appropriate adjustment of the distances and angles, a vertical narrow red stripe is imaged on the CCD sensor, which is located relatively far to the right of the sensor. A mercury lamp is excellently suited for calibration with its wide discrete light spectrum and provides information on which wavelength range is imaged on the CCD sensor. Each light source with known and constant light spectrum in the visible range is suitable for calibration of the Merlin spectrometer. When evaluating the measured values, it should be noted that the spectral response of the CCD sensor is not constant and drops significantly as of a wavelength of 700 nm. You can find more details in the link below:

https://www.coptonix.com/html/laith_i_ccd.html



Figure 4: Completed Merlin spectrometer with outer case, nucleo, Raspberry Pi and LCD display.

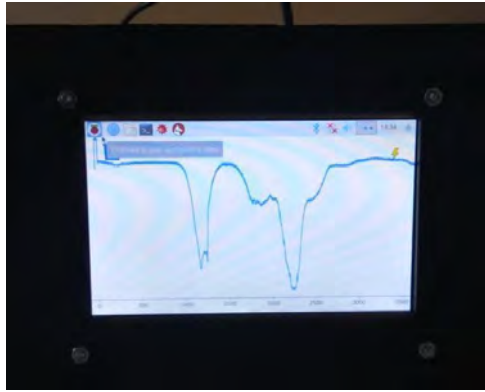


Figure 5: Ready-to-use Merlin spectrometer after fine calibration.

After careful alignment and verification of the spectral resolution. Can the measurement signals be evaluated via a laptop or the Raspberry PI. Note, intensity peaks are inverted by the CCD sensor as valleys.

Have fun and success with your Merlin spectrometer!

DIY microscopy

From Hackteria Wiki

Contents

- 1 Nice Instruction
- 2 DIY microscopy
 - 2.1 Introduction
 - 2.2 Video Examples
- 3 Laser-cut microscopy stages
- 4 Instructions
 - 4.1 Translations
 - 4.2 0. Introduction and Materials
 - 4.3 Parts/Material List
 - 4.4 1. Conversion of the webcam Part A: Small enlargement
 - 4.5 1. Conversion of the webcam Part B: Maximal enlargement
 - 4.6 2. Construction of the platform
 - 4.7 3. The light source
 - 4.8 3.B Hacking the LEDs from the Webcam (to be documented)
 - 4.9 4. Using the Microscope and Hunting for Microorganisms
- 5 The Stage
- 6 Other Instructions
- 7 Different samples
- 8 old stuff
 - 8.1 Hacking the webcam
 - 8.2 mounting the microscope
 - 8.3 Magnification and Field of View
 - 8.4 Where to get them, and which models
 - 8.5 Booklet for printing and folding (for kids and only in german)
- 9 hacking a digital camera
- 10 some notes about DIY microscopy
- 11 Makerversity DIY version
- 12 Links on Microscopy
 - 12.1 Historical
 - 12.2 General Resources
 - 12.3 DIY Microscopy
 - 12.4 Programming
 - 12.5 Image Processing and Analysis
 - 12.6 Webcam and Video

Nice Instruction

Home Made Bio Electronic Arts Do-it-yourself: Microscopes, Sensors, Sonifications - Christoph Merian Verlag / Migros-Kulturprozent: Dominik Landwehr, Verena Kuni (Ed.), 2013

<http://hackteria.org/2013/05/23/home-made-bio-electronic-arts-published/>

The Chapter about the DIY microscope can be downloaded here (<http://hackteria.org/wp-content/uploads/2013/05/hm3-hackteria-pages.pdf>).



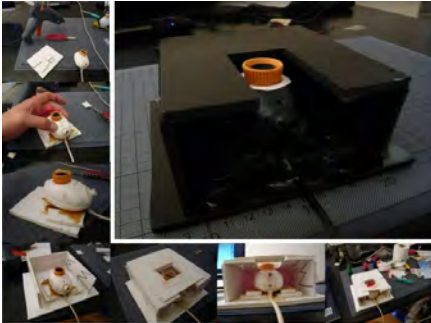
And available now with Chinese translation included! Thanks to I-Chern Lai and Dimension+ (<http://dimensionplus.co/>)! Download it here (<http://hackteria.org/wiki/images/2/27/HomeMadeChinese-hackteria-DIYmicroscope.pdf>)

See the other chapters of Book: Homemade Biological Art

DIY microscopy

Introduction

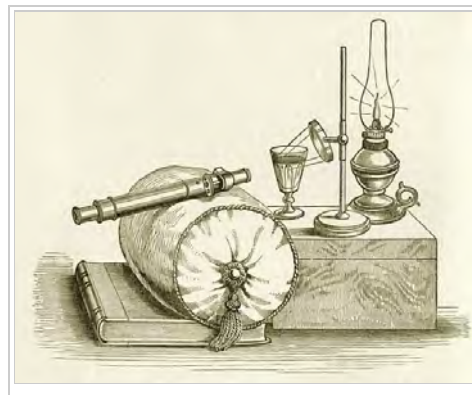
To use a simple usb webcam as a microscope, only a few modifications are needed.

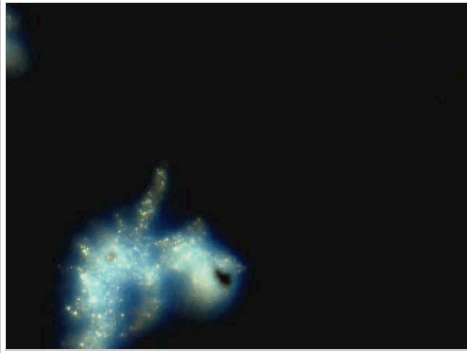


In short, a small hack to the optics of a standard webcam with an adjustable focus-lens, allows to create video data, with a magnification of around 100 to 400x (depending on the model) at a working distance of a few mm. The highest magnifications can be achieved by inverting (putting upside down) the lens. Addition of good lighting by the use of leds allows to create images using a bright-field method (shine through the stuff) or dark field method (look at the reflections and scattering).



The Chapter about the DIY microscope can be downloaded here (<http://hackteria.org/wp-content/uploads/2013/05/hm3-hackteria-pages.pdf>).





dark-field image sequence (4 sec) of an amoebae
recorded on a modified webcam



bright-field image sequence (4 sec) of an amoebae
recorded on a modified webcam

Webinar on DIY microscopy English / Portuguese

<https://www.redepesquisadores.org/uso-de-microscopios-diy>

#46 - Uso de microscópios DIY em projetos de Ciência Cidadã



Video Examples

Movie recorded with modified webcams: Hackteria in Berlin (http://www.youtube.com/watch?v=uIFMqmSjTMc&feature=channel_page)

see more on wetPONG (http://wetpong.net/wetpong/wiki/index.php?title=DIY_Mikroskopie_Technorama#Film_Beispiele)

<http://www.youtube.com/watch?v=-BgTDjYrIV8>

Laser-cut microscopy stages

Laser-cut microscopy stages are here.

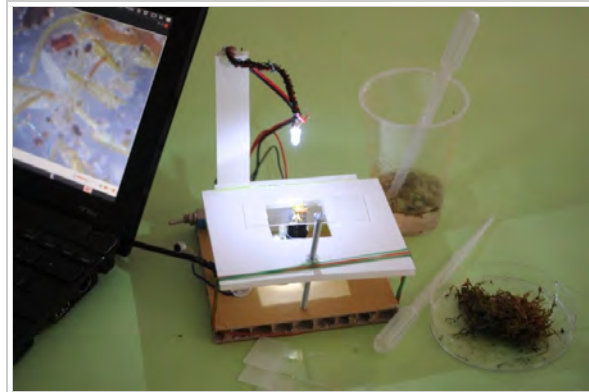


Instructions

Translations

Thanks for helping us translating this instruction. If you don't have an account on this wiki, contact dusjagr (<mailto:marc@usseiller.ch>).

- DIY Mikroskop Anleitung (Deutsch)
- DIY Microscopy Instruction (Chinese)
- DIY Microscopy Instruction (Portuguese)
- DIY Microscopy Instruction (Spanish)
- DIY Microscopy Instruction (Italian)
- DIY Microscopy Instruction (Bahasa Indonesia)
- DIY Microscopy Instruction (French)
- DIY Microscopy Instruction (Japanese)
- DIY Microscopy Instruction (български)
- DIY Microscopy Instruction (Finnish)
- DIY Microscopy Instruction (Slovenian)
- DIY Microscopy Instruction (Hindi)
- DIY Microscopy Instruction (Serbian)
- DIY Microscopy Instruction (whadever language)



The Chapter about the DIY microscope can be downloaded here (<http://hackteria.org/wp-content/uploads/2013/05/hm3-hackteria-pages.pdf>) and available now with Chinese translation included! Thanks to I-Chern Lai and Dimension+ (<http://dimensionplus.co/>)! Download Chinese (<http://hackteria.org/wiki/images/2/27/HomeMadeChinese-hackteria-DIYmicroscope.pdf>)

0. Introduction and Materials

Making the DIY MICROSCOPE includes converting an ordinary webcam into a microscope. The webcam's conversion can be quickly effected manually. The electronics remains unaltered, only the position of the lens is changed. A solid platform enables fixing and accurately focusing the tiny study objects. The objects are illuminated with a light-emitting diode (LED).

The DIY MICROSCOPE consists of three components, assembled in this sequence:

- Converted webcam
- Stable platform for observation
- Illumination with a light-emitting diode (LED)

Parts/Material List

Basics

- 1 webcam
- Cardboard (thick) / wood, 20 x 30 cm
- Foamboard, 20 x 30 cm
- M4 adjustable screw, approx. 15 cm long, with fitting screw nuts
- Duct tape
- Blu-Tack adhesive
- Hot glue
- Rubberbands

Tools

- Cutter / sharp knife
- Screwdriver, small
- Hotglue gun



- (optional) Soldering iron

Optional external LED light source

- 1 switch
- 1 white light-emitting diode (LED)
- 1 battery (9V)
- 1 wired battery connection
- 1 resistor (1 k Ω)
- 1 potentiometer (20 k Ω)
- 30 cm insulated wire
- Garden wire

Microscopy and Micro-Hunting equipment

- Some transparent plastic cups
- Glass slides
- Petri dishes, made of plastic or glass
- Disposable pipettes
- Waterproof pen
- Small chrome steel spoon
- Tweezers
- Sealable plastic containers for samples

1. Conversion of the webcam Part A: Small enlargement

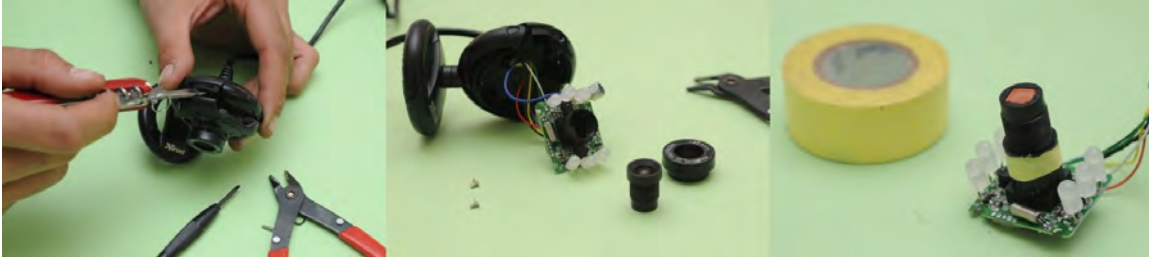


- A selection of standard webcams. Best suited are models allowing for manual adjustment of focus by turning the ring on the lens. The only solution is by trial and error.
- Before the camera is modified, it needs to be tested. For that it has to be connected to a computer, and additionally the necessary drivers have to be installed. Webcams run with Windows, Mac, or Linux.



- Already with this configuration the webcam can be used to inspect objects up close. You only need to screw out the lens a little and move closer to the object. A pocket lamp improves lighting conditions.
- Pointing the webcam on tiny objects produces surprising effects: Even without modifications one begins to see things hidden to the naked eye.

1. Conversion of the webcam Part B: Maximal enlargement



- Now we begin dismantling the webcam. The screws are removed. Partly such screws are hidden beneath labels or rubber caps. With a solid tool – in this case the screwdriver of a Swiss Army knife – the webcam 's cover is removed.
- The appliance 's interior can now be seen: it consists of optics and an electronic switch. We can do without the light-emitting diodes (LEDs). We shall later construct our own light.
- The optics is partially glued on. By careful twisting we can detach it from the electronics. The optics' outer ring (at the right of the picture) will no longer be used later. It only serves as decoration.
- With the use of a strong side cutter we cut through the plastic casing. Now the electronics including all wires and the USB cable can be removed from the casing.
- The webcam's interior: on the left side of the picture we can see the internal microphone, which, however, is not needed for our project.
- Now we place the optics upside down on the fitting. It can no longer be screwed on and must therefore be firmly secured. The optics is attached with a piece of duct tape.
- To test the equipment we connect the modified webcam with the computer and point the lens towards the screen. Now the individual

RGB pixels on screen become visible.

2. Construction of the platform

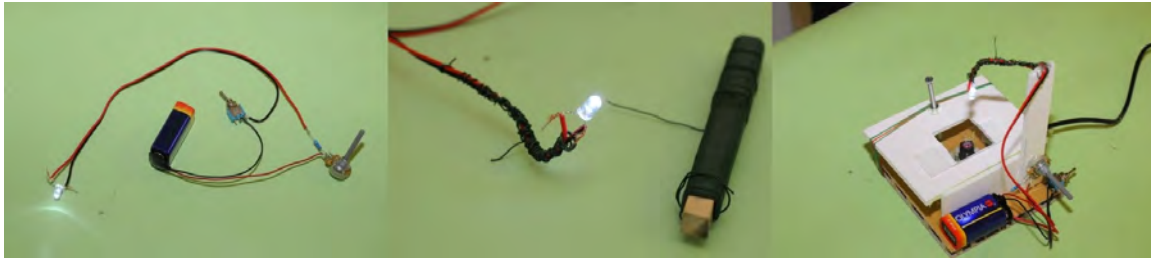


- Using small lumps of Blu-Tack adhesive, the webcam is attached to a solid pasteboard of about 15 x 15 cm.
- The platform's side wall consisting of scale model cardboard. With a pencil we draw the height of the lens on it and cut off the cardboard along that line. We use hot glue for pasting.
- Using a carpet cutter, we cut a rectangular opening into another piece of scale model cardboard. This piece too is attached with hot glue.



- The adjustable screw requires a hole. We attach the screw nut right at the top with a small drop of hot glue. Then we insert the adjustable screw. It must reach down to the lower platform.
- Rubber bands provide more stability to the platform. With the screw the scale model board can now be moved up and down by a few millimeters.

3. The light source



- Our microscope also has a light source in the form of a light-emitting diode (LED). The lighting can be easily produced by oneself.
- In this easy way, the wires can be twisted together. But it is safer if they are soldered on.
- The centimeters long feed of our light source is wrapped with garden wire. The wire thus becomes pliable and later can be attached in any position.
- The light source, potentiometer and battery are attached to our construction with hot glue. Our DIY MICROSCOPE is ready for use.

3.B Hacking the LEDs from the Webcam (to be documented)

- Coming soon

4. Using the Microscope and Hunting for Microorganisms



- The USB cable of the converted webcam is connected to the computer. Now we can begin with our examinations.
- The study objects are placed on a glass slide and can be shifted by hand. The microscope's focus is regulated by the adjustable screw.
- As with a professional microscope, with our DIY tool we are able to take electronic photos and even films. Photos and films are digitally available, can be further processed and of course be easily published on the Internet.

The Stage



More info about stage designs and laser-cutting files are on [Laser-cut microscopy stages](#) are here.

Other Instructions

- Z-servo control of Focus: <http://www.instructables.com/id/DIY-Microscope/?ALLSTEPS>

Different samples



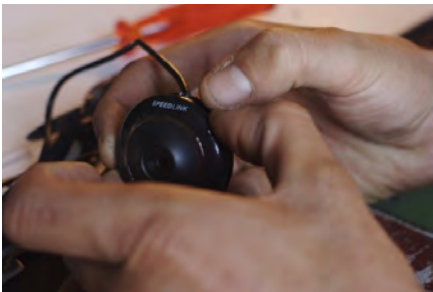
old stuff

Hacking the webcam

Step1:



Step2



Step3



Step4



Step5



Step6



Step7



Further modifications

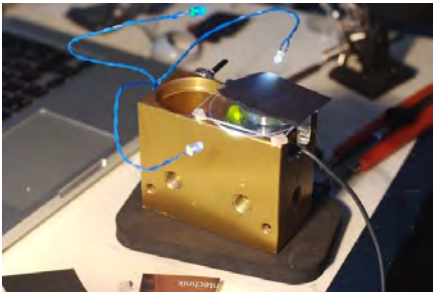
mounting the microscope

There are many ways to finally build the microscope itself. here are a few examples from the workshop *hackteria & lab_hacking @ NK, Berlin*.

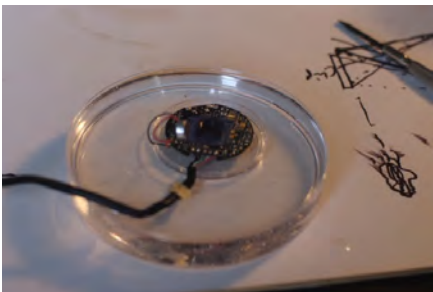
Simple microscope setup



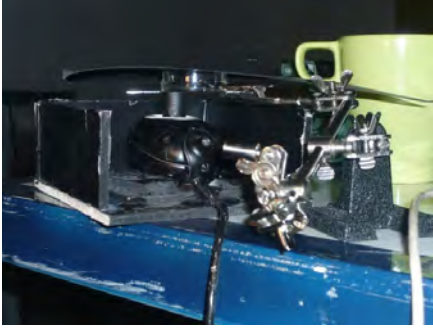
Fixed, massiv and stable setup



Silicone embedded setup



Tape and cardboard setup



Magnification and Field of View

See: fieldofview for more details.

after completing the hack with the lenses, the magnification can be increased upto a field of view of 0.7 mm.



Where to get them, and which models



Am besten auf ebay aus hongkong bestellen (5-10 CHF). Billige modelle eignen sich generell am besten. an sonsten in mediamarkt oder pearl vorbei schauen (15-20 CHF).

deal extreme (<http://www.dealxtreme.com>)

Booklet for printing and folding (for kids and only in german)

http://hackteria.org/wp-content/uploads/2010/10/Zine_empty_layout_nina2.pdf

File:Zine empty layout nina2.pdf

hacking a digital camera



some notes about DIY microscopy

For more enlargement, you can not only invert the lense but also put some (iron) rings between the lense and the "webcam" and fix it with duct tape. The more rings you put between the more light you will need that you can see something. 5mm works without problems, the light from 1-2 LEDs will suffice to see the things.

For savers: A cheap solution is a standard logitech webcam, which can be bought for about 25.- SFr. --> videos(500x600), pics (3MPixel)

Makerversity DIY version

File:Makerversity-DIY_Make-Your-Own-Microscope.zip

Links on Microscopy

Historical

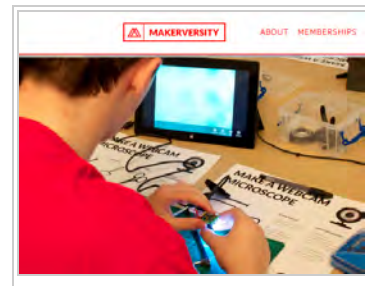
- Anthony van Leeuwenhoek Self-made Scientist, Father of Microbiology & Microscope Inventor (http://microbiology.suite101.com/article.cfm/anthony_van_leeuwenhoek)

General Resources

- Lichtmikroskopie (<http://www.mikroskopie.de>) – Sehr guter und interaktiver Überblick der Lichtmikroskopie
- Microscopy-UK Resources (<http://www.microscopy-uk.org.uk/>)
- ROTHAY HOUSE: Using the Digital Microscope, Brian J. Ford (<http://www.brianjford.com/w-rothe.htm>)
- SynbioUK on microscopy tools (<http://www.synbio.org.uk/web-resources/lab-tools/microscopy.html?start=20>)

DIY Microscopy

- Cellphone Microscope (<http://www.youtube.com/watch?v=VH5H6uSQUFE>)



- Hackteria DIY Microscopy (<http://hackteria.org/?p=52>)
- SYN BIO - Link Sammlung zu Mikroskopie im Selbstbau (<http://www.synbio.org.uk/hardware/microscope-construction.html>)
- pocket microscope (<http://www.microscopy-uk.org.uk/mag/artdec06/aa-pocket-micro.pdf>)

Programming

Pure Data

pure data (<http://puredata.info/>)

Pd (aka Pure Data) is a real-time graphical programming environment for audio, video, and graphical processing. It is the third major branch of the family of patcher programming languages known as Max (Max/FTS, ISPW Max, Max/MSP, jMax, etc.) originally developed by Miller Puckette and company at IRCAM. The core of Pd is written and maintained by Miller Puckette and includes the work of many developers, making the whole package very much a community effort.



pd_microscope

We have developed several patches for the pd_microscope

or see more here: New pd-microscope patch (<http://hackteria.org/?p=2149>)

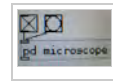


Image Processing and Analysis

ImageJ

ImageJ (<http://rsbweb.nih.gov/ij/>)

ImageJ is a public domain Java image processing program inspired by NIH Image for the Macintosh. It runs, either as an online applet or as a downloadable application, on any computer with a Java 1.4 or later virtual machine. Downloadable distributions are available for Windows, Mac OS, Mac OS X and Linux.



CCV

CCV (<http://ccv.nuigroup.com/>)

Community Core Vision, CCV for short (aka tbeta), is an open source/cross-platform solution for computer vision and machine sensing. It takes an video input stream and outputs tracking data (e.g. coordinates and blob size) and events (e.g. finger down, moved and released) that are used in building multi-touch applications. CCV can interface with various web cameras and video devices as well as connect to various TUIO/OSC/XML enabled applications and supports many multi-touch lighting techniques including: FTIR, DI, DSI, and LLP with expansion planned for the future vision applications (custom modules/filters).



This project is developed and maintained by the NUI Group Community. We encourage you to get involved.

Webcam and Video

VideoLan

VideoLan (<http://www.videolan.org/>)

VideoLAN is a project, run by volunteers, backed-up by a non-profit organisation, which produces free and open source software for multimedia, released under the GNU General Public License.



AMCap

AMCap (<http://noeld.com/programs.asp?cat=video>)

AMCap is a small yet fully functional video capture application compatible with Microsoft DirectShow.



macam

macam (<http://webcam-osx.sourceforge.net/>)

macam is a driver for USB webcams on Mac OS X. It allows hundreds of USB webcams to be used by many Mac OS X video-aware applications. The aim is to support as many webcams as possible.



gucvview

GTK+ UVC Viewer (<http://gucvview.berlios.de/>)

This project aims at providing a simple GTK interface for capturing and viewing video from devices supported by the linux UVC driver, although it should also work with any v4l2 compatible device.



ffmpeg FFmpeg (<http://www.ffmpeg.org/>)

Command line converter of all video formats and all platforms. <http://stephenjungels.com/jungels.net/articles/ffmpeg-howto.html>

Retrieved from "http://www.hackteria.org/wiki/index.php?title=DIY_microscopy&oldid=29585"

Category: Pages with broken file links

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- This page was last modified on 14 November 2018, at 16:34.

DIY handheld centrifuge

From Hackteria Wiki

Contents

- 1 INTRODUCTIONS
- 2 You will need,
- 3 PROCEDURE
 - 3.1 How our centrifuge functions
 - 3.2 Making a Hand-held Centrifuge
 - 3.3 Picture Reference :
- 4 PRECAUTIONS

INTRODUCTIONS

A centrifuge is a rotating body with very high RPM. The vial holders at the edge of the body spinning at high rpm are used to separate substances of different densities.

You will need,

1. A hand-blender
2. A circular disc/ a fan/ wheel or anything which is fit enough to spin on the blender's blade. It needs to be a little bigger than a tea-cup's saucer.
3. PVC pipe; long enough to cut out six pieces which would fit test-tubes inside, the width will need to be a little larger than that of the test-tube.
4. Pipe caps to seal off the bottom of each pipe-piece.
5. Synthetic wire, about 2mm thick.
6. A drill, with a 1 or 2mm drill bit.
7. A cutter and a mini hack saw.

PROCEDURE

How our centrifuge functions

we have used a hand blender with rpm and attached a disk onto it to make our rotating body. to this disk we have connected holders for the vials, thus making a centrifuge.

Making a Hand-held Centrifuge

To make the rotating body,

1. If the blender's blade is surrounded by a border, saw it off, it'll be easier to fix the disc/wheel/fan this way.
2. Take the disc/ wheel/fan place it over the blades of the blender, make sure it's centered. Mark the points of the blades on the disc/wheel/fan.
3. Drill holes in the disc/wheel/fan where the points were marked, use a cutter and make the holes wide enough to fix the blades into them.
4. If there is no provision on the disc/wheel/fan to tie the test-tube holders, make six holes on the edge of the disc/wheel/fan to do so.
5. Now, fix the disc/wheel/fan onto the blender's blades. To secure use Emseal around, over and under the area where the blades protrude out of the disc/wheel/fan.
6. Let it dry completely.(Making sure it's dry is very important.)

To make Test-tube holders,

7. Cut up the PVC pipes into six pieces.
8. Drill two holes at the edge of the pipe, one at each end of the Diameter of the pipe.
9. Fix the Pipe caps at the bottom of each pipe, if they are loose, seal them off with the sealant.
10. Pass one wire through each hole, knot it so it doesn't slip through the hole.

Finally,

11. Once the sealant on the blender's blade has dried up completely, tie up the ends of each wire in the pipes onto the holes on the edge of the disc/wheel/fan. Make sure the knots are all very strong.

Picture Reference :



saw off border of the blade



mark the points of the blade



fix disk on blade



final product

PRECAUTIONS

1. Handle blade and other sharp objects with care.
2. While operating final product hold away from body and face, if possible use a protective shield, ex: a riding helmet.
3. Be careful while testing the product for the first time, use plastic test tubes or similar objects rather than a glass test tube; there is a chance of the caps on the holders giving way and the test tube shooting out; this could be extremely dangerous to any one standing around the area(trust us).
4. Make sure the blender's motor doesn't get too hot, when hot allow it too cool down before using again.

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- This page was last modified on 10 December 2010, at 19:03.

DIY Incubator

From Hackteria Wiki

Contents

- 1 INTRODUCTION
- 2 You will need,
- 3 PROCEDURE
 - 3.1 How our box functions
 - 3.2 Our Process
 - 3.3 Ref photos
- 4 PRECAUTIONS
- 5 DIY Incubator with simple electronic control
- 6 DIY Incubator with Temperature Control
 - 6.1 Fermento
 - 6.2 Incuba libre
 - 6.3 Other incubator projects
- 7 The Cheapest incubator electronic control in the world, thx ali!

INTRODUCTION

An incubator is an isolated storage place that is used for cultivating bacteria. The incubator maintains optimal temperature of the atmosphere inside it. Incubators are essential for a lot of experimental work in cell biology, microbiology and molecular biology and are used to culture both bacterial as well as eukaryotic cells. The simplest incubators are insulated boxes with an adjustable heater, typically going up to 60 to 65 °C (140 to 150 °F), though some can go slightly higher (generally to no more than 100 °C). The most commonly used temperature both for bacteria such as the frequently used E. Coli cells is approximately 37 °C, as these organisms grow well under such conditions. They also need a circulation system for equal distribution of heat in the box.

We made a simple incubator that maintains a temperature of 37 °C using materials that are easily available. This incubator will be used cultivate E.Coli.

You will need,

1. Styrofoam box.(doesn't conduct heat).....



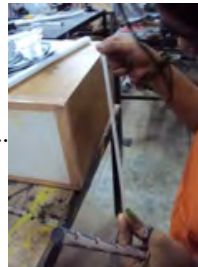
2. heating element.(bulb,heating pad,etc.).....



3. cabinet fans.(depending on size of box).....



4. thermometer.(between 20 °C to 100 °C).....



5. 12V adaptor.(for powering fans).....



6. conducting wire.(adapter to fans).....



7. insulation tape.

PROCEDURE

How our box functions

The styrofoam box is an insulated box that keeps the heat locked inside. The heating element is introduced into the box to produce heat. The cabinet fans are used to circulate the heat inside and keep the temperature same everywhere in the box. A thermometer is introduced into the box through a perfect fitting hole in the box to measure the temperature inside. the hole is then well sealed and insulated. Neither the heating element nor the fan must be too close to the thermometer. **The fans and heating element must be placed in such a way that the required temperature is achieved**(Not as easy as it seems). once the placement is finalized, stick the fans and the heat source in place using arelldite. The lis of the box must be sealed properly so as to not let any exchange take place(duct tape). The incubator is ready to use.

Our Process

Day 1

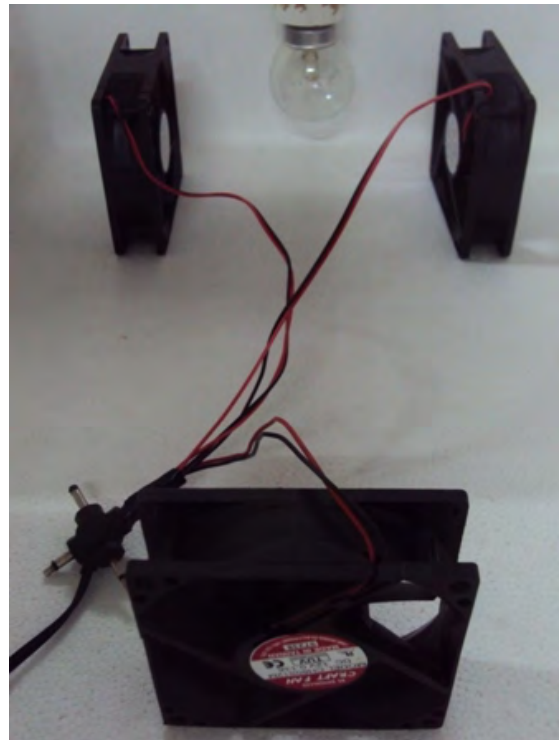
We first experimented with a dummy styrofoam box that we got at a juice centre. we first started with a 75 watt bulb and 1 fan. the fan was placed exactly opposite to the bulb. We also used a layer of al foil to increase heat.The temp reading showed 108°C. and the thermometer bursted. WE then scraped the Al foil idea.

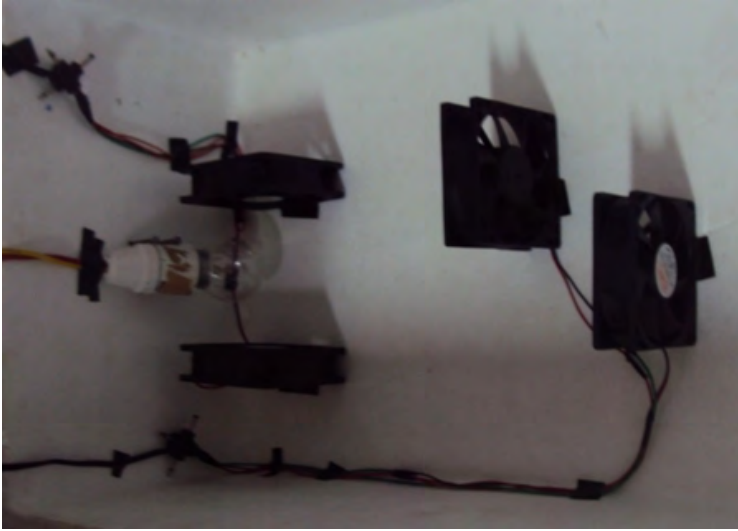
Day 2

We then tried using a 40 watt bulb in the dommy with 3 fans.We placed the fans in such a way that the air circulated evenly through the box. The trmperature shot up to 40°C in the first 20 minutes and then remained constant at 60°C. We thought of having an outlet for the heat to escape and use the fan as an exhaust. This was not safe as there might be a possibality that some microbes may enter the incubator. so we used a bulb of lower wattage.

Day 3

We used a 0 watt bulb in the dummy box along with 3 fans. the new box had also arrived so we tried the same combination in the new box since it was bigger. The readings were as follows:





Dummy Box

Time(min).....Temp(°C)

0.....	33
1.....	34
3.....	35
5.....	36
6.....	37
8.....	38
10.....	39
13.....	40
17.....	41
20.....	42
29.....	43
43.....	44
65.....	45(const)

Final box

Time(min).....Temp(°C)

0.....	31
2.....	32
3.....	33
4.....	34
5.....	35
7.....	36
9.....	37
11.....	38
15.....	39
21.....	40
33.....	41
53.....	42(const)

Day 4

today we used 4 fans to reduce temp. The final temp came to 40°C. We also jumped to the conclusion that each fan reduces the temp of about 20°C, which was wrong.

Day 5

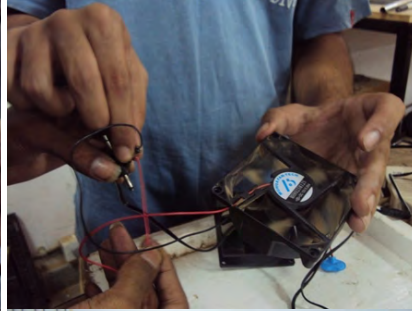
Today we tried to reduce the wattage further by using a mosquito repellent heater. we also used 4 fans in such a way that the air circulates in 2 circles. the temperatures recorded were as follows:

Time(min).....	Temp(°C)
0.....	29
1.....	30
2.....	31
4.....	32
5.....	33
6.....	34

8.....35
11.....36
20.....37
60.....37(const)

Thus we got a constant temperature of 37°C which is the apt temp for E.coli.

Ref photos





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PRECAUTIONS

1. Do not put fans right in front of heater as its constant temperature will drop over time.
2. Do not use a normal thermometer, it cannot take temperature more than 108°F and might burst.
3. If by any chance the thermometer breaks and the mercury spills, dispose it safely without touching it directly.
4. Switch off main power before doing connections.
5. Run the incubator for about half an hour before use

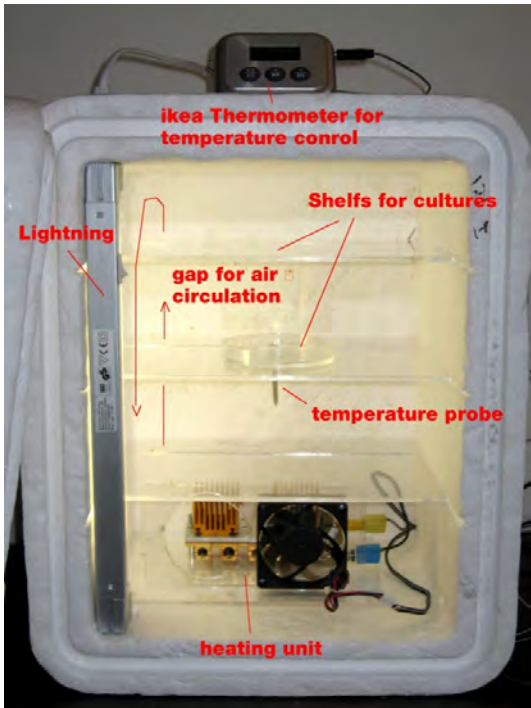
DIY Incubator with simple electronic control



DIY Incubator based on above description, using power resistors for heating and an electronic thermometer to control the temperature automatically. Thus the temperature can be set and will be regulated.

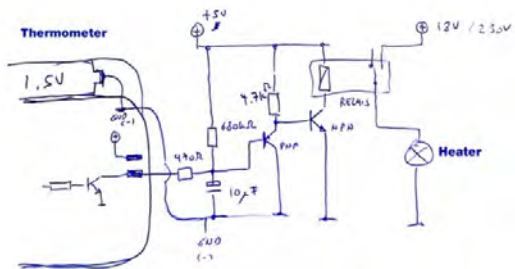


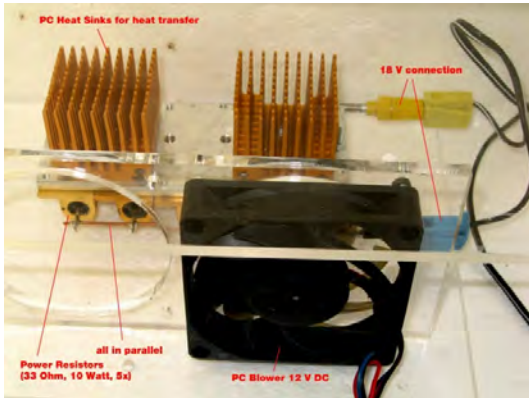
Peephole





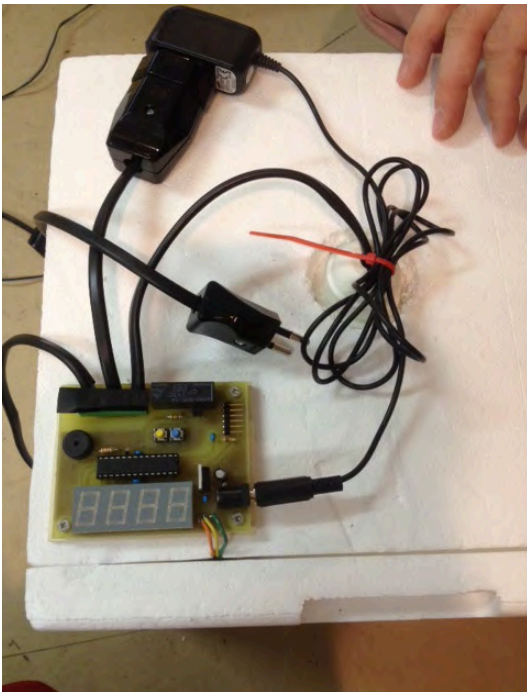
<http://www.ikea.com/ch/de/catalog/products/20103016/>





DIY Incubator with Temperature Control

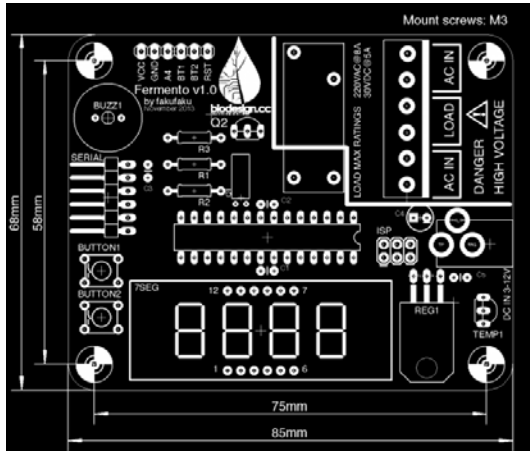
Fermento



The incubator design (<http://biodesign.cc/2013/12/25/diy-incubator/>) from the biodesign for the real world workshop is a simple one. It relies on a single heating element (a light bulb), a temperature sensor, and a control board that controls how long the light bulb is on/off according to the sensor reading.

The circuit board is available in two versions. A simple single sided version for home printing (homebrew) and a more fancy two sided version with all the bells and whistles to send to a PCB fab service (Gerber files available).

All the design and firmware available in a github repository (<https://github.com/BioDesignRealWorld/Fermento/>).



Incuba libre

Even cheaper, based on Attiny85 and PID control of temp regulation.



<https://github.com/BioDesignRealWorld/IncubaLibre>

Other incubator projects

<http://www.instructables.com/id/Portable-Laminar-Flow-Hood/?ALLSTEPS>

The Cheapest incubator electronic control in the world, thx ali!

<http://usefulldata.com/cheap-12v-temperature-controller-xh-w1209-with-display-and-probe-review/>

and you can hack it! (<http://pastebin.com/xwx4QK7m>)

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