

DIY-MICROSCOPY

Dokumentation

Manuel Janke

112 188

Introduction

You are just a few steps away from building your own microscope. First of all you have to think about what do you want to look at and how this should look in the end. With the components from the webcam you can do two different kinds of illumination for your object to look at.



Bright field microscopy

The light comes from above and the contrast arises because of absorption of light in the sample.



Dark field microscopy

The light comes from camera direction.

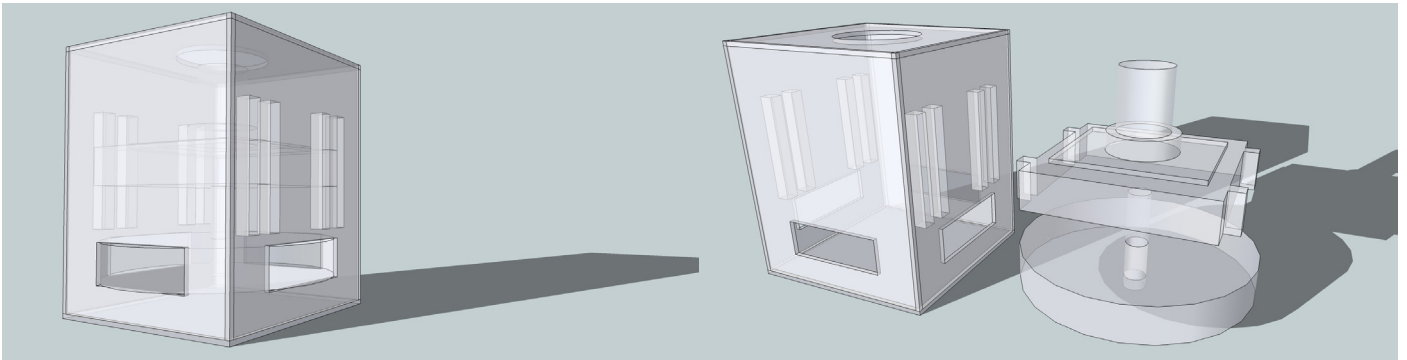
* You can also combine the two methods

There are many possibilities how your microscope in the end works and looks. This is just a suggestion and the way I build it. For some general information and ideas have a look on this:

<http://www.uni-weimar.de/medien/wiki/GMU:DIY-Microscopy>

My construction

My premises were maximum mobility and maximum opportunities of taking images in the future. I thought of a compact box with the cam inside and bright field microscopy and dark field microscopy should be combined. The actual problem for the housing is to move the lense or the object very slightly to get a sharp picture because the focus range is very tiny. So I thought about a big wheel for transmitting the slight movement to get control. The lens is mounted on a carriage with the head of the screw inside. The position of the wheel with the nut inside is fixed and so the screw moves up and down by turning the wheel.



What you need

1x cheap webcam, important is that the cam works without installing drivers (plug n play). The more money you'll spend the more resolution you'll get / 1X 1mm gray cardboard (for our lasercutter 58x28 cm) / 1x m5 screw + nut (with head max. 2,6 cm) / 1x cross-head screwdriver for little screws / 1x pliers / 1x woodglue / some wire / lasercutter (or just a cutter) / some rubber band

Steps/Tutorial

Cam: hama PC-Webcam AC-150



Taking apart:

1. Remove the lens cap.

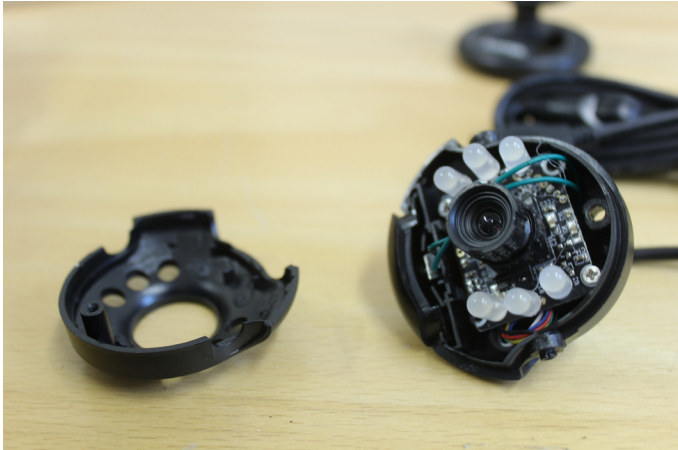


2. Remove the stand. Therefore remove the little screws on the side with a cross-head screwdriver and splay the ends of the stand.



3. Remove the screw on the back.

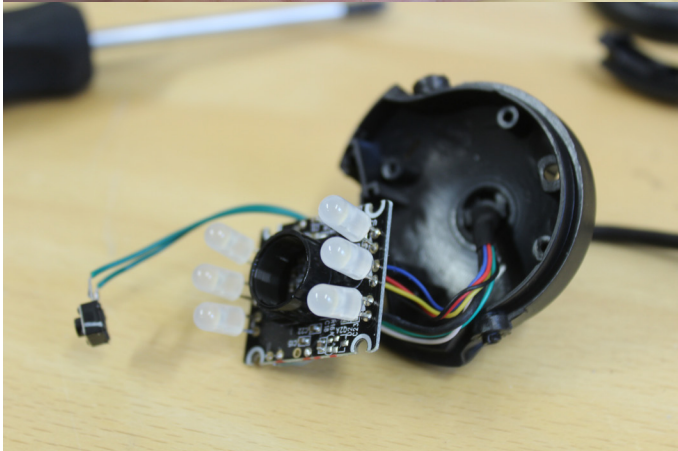




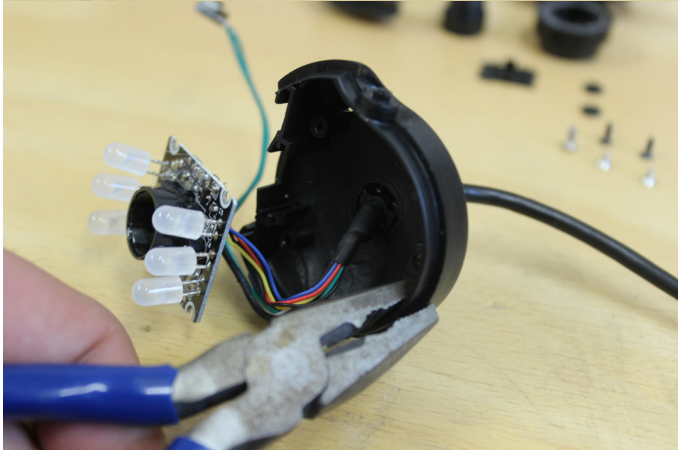
4. Open the housing.



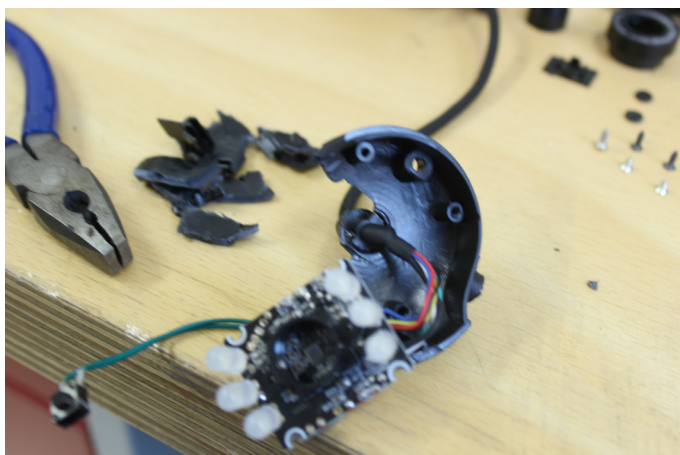
5. Remove the button on the top and the loose plastic parts



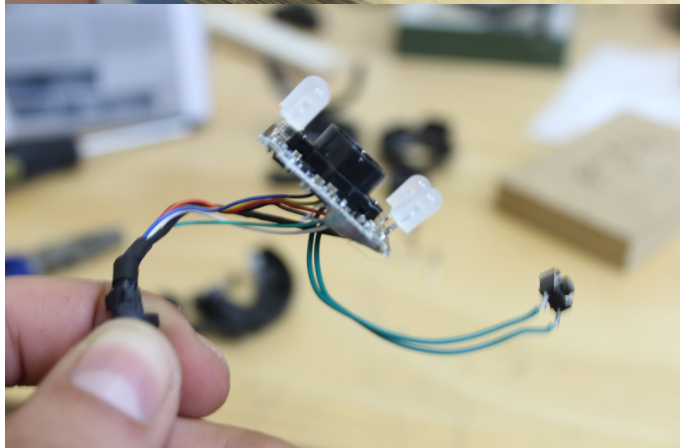
6. Take out the PCB with the lens.



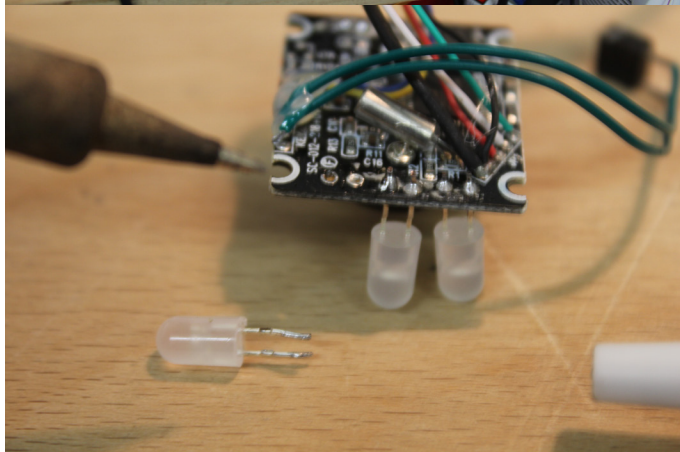
7. Take a pliers and its very important to be gently now. Crush the plastic to exempt the cable.



8. Now you have what you need. Actually you are done because I don't need to unsolder the LEDs because I want to have light inside the housing to illuminate surfaces for the darkfield microscopy. But if you want to use the LEDs in an other position or general otherwise I'll show you how to unsolder them.



9. You need a soldering iron with a fine tip. Heat it to about 300 °C.



10. Melt the tin and remove it with an unsoldering pump. With a kind of air stream it absorbs the melted tin and you can take of the LED.

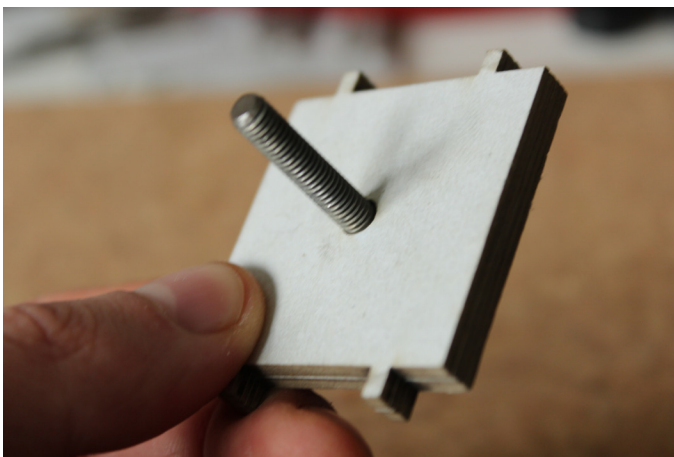


11. In the end it looks like this. Now you just have to flip the lens and it works like a mikroskop. You can glue it on the PCB with a hot glue gun but I didn't do this because I played a little bit with the distance between lens and ccd.

Steps/Tutorial Housing

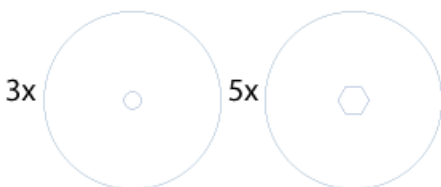
The draft for the laser cut is in the "Dokumentation" folder.

Vorlage_Laserschnitt_Mikroskop_Pappe1mm.ai
or *Vorlage_Laserschnitt_Mikroskop_Pappe1mm.pdf*



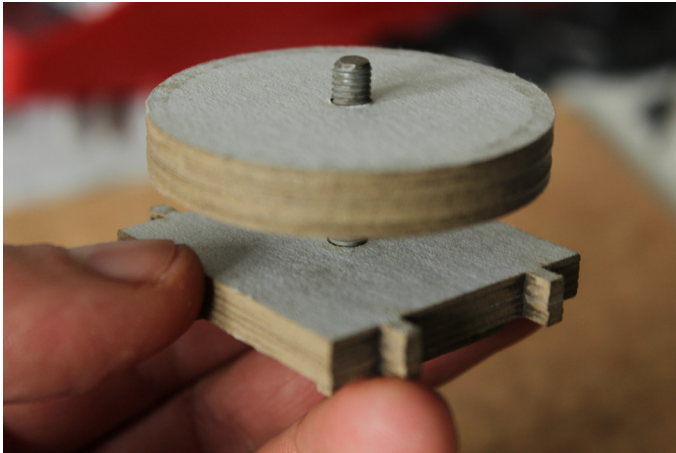
1. Take all of this squares and the m5 screw. Glue them together in this order:

- the two without hole
- all of them with the hexagon hole
- put the screw head in the hole
- lead the last square over the thread and glue it below the others

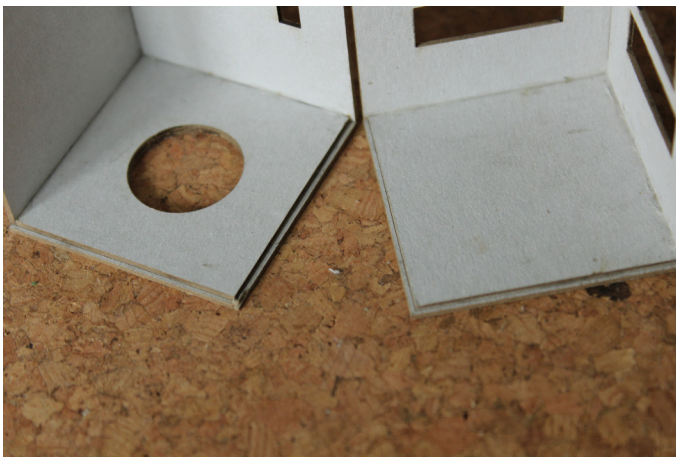
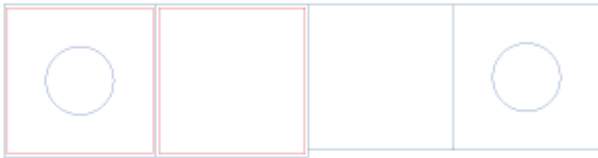


2. Take all of the circles and the nut. Glue them together in this order:

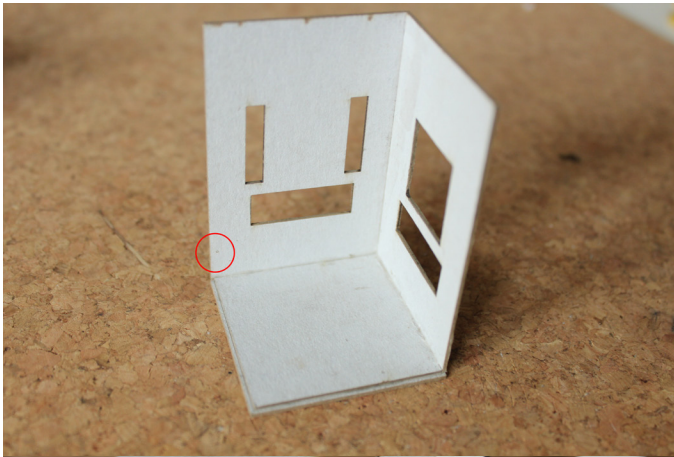
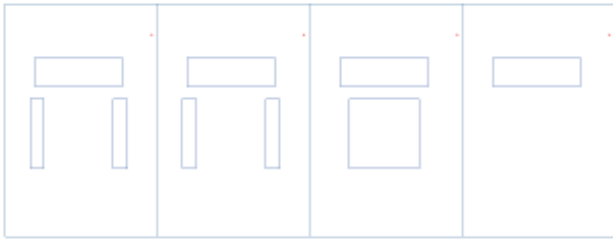
- two with a small hole
- all of them with the hexagon hole
- put the nut in the hole
- close it with the last one with a small hole



3. Turn the circles with the nut inside on the thread.

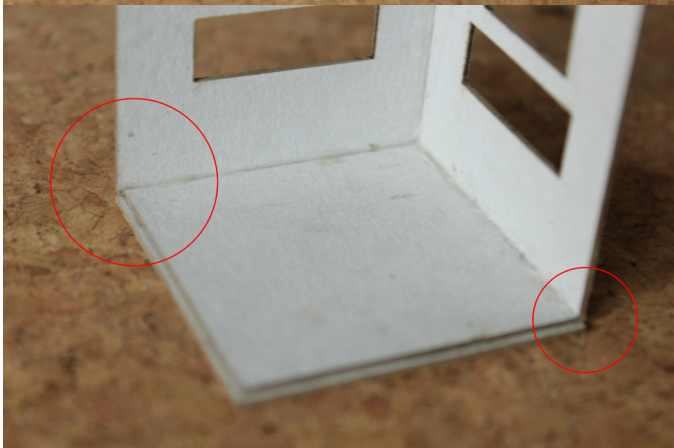


4. Take these ones and glue the little ones in the marking on the suitable bigger ones. The one with the hole inside is the top of the housing and the other one is the bottom.



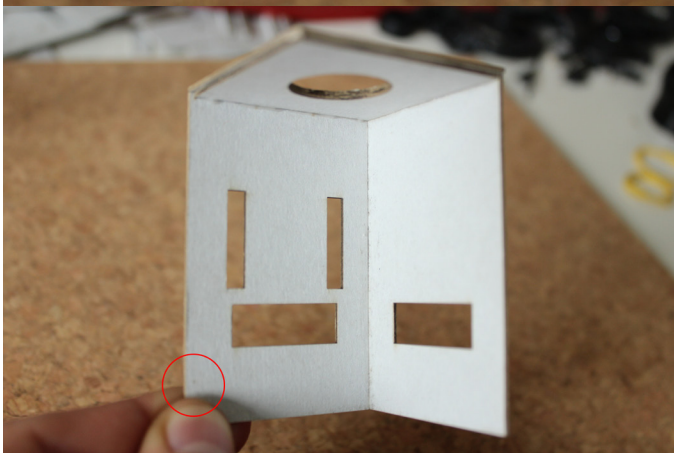
5. Now take the rectangles. The red dot marks the bottom side!

The small sides are 1mm smaller than the sides of the squares from step 4 for the matching accuracy and the red dot marks the side where you have to put the rectangle to the selvage! So take two different rectangles and glue it to the bottom square. The same with the other two rectangles and the top square.

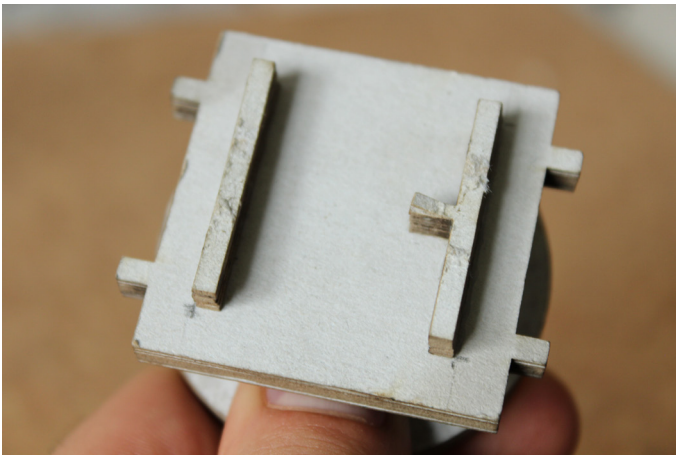
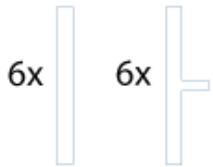


Please take some time and try it without glue before you put it together!

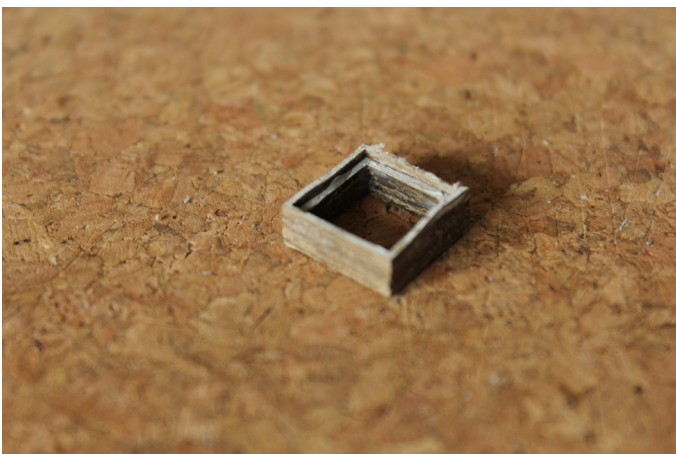
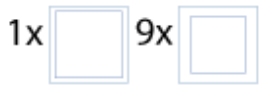
- the dot marks the side where you have to put the rectangle to the selvage, on the other side there is 1 mm space



- the whole top part, the dot is still on the bottom side

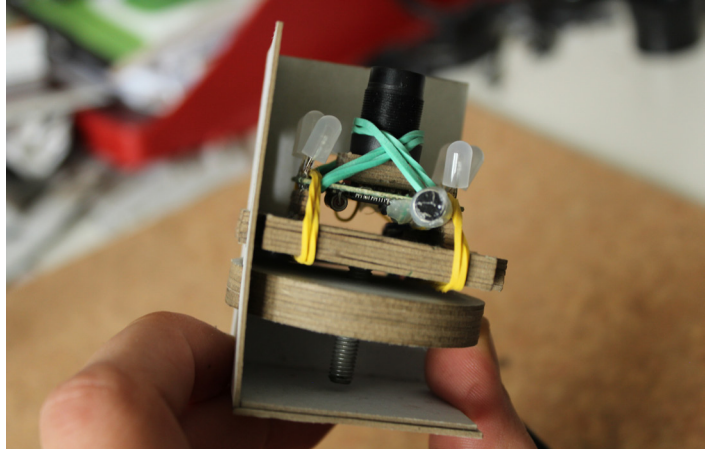
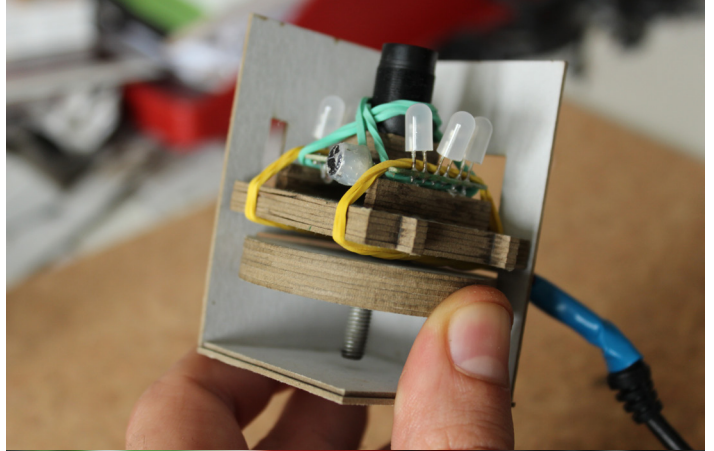
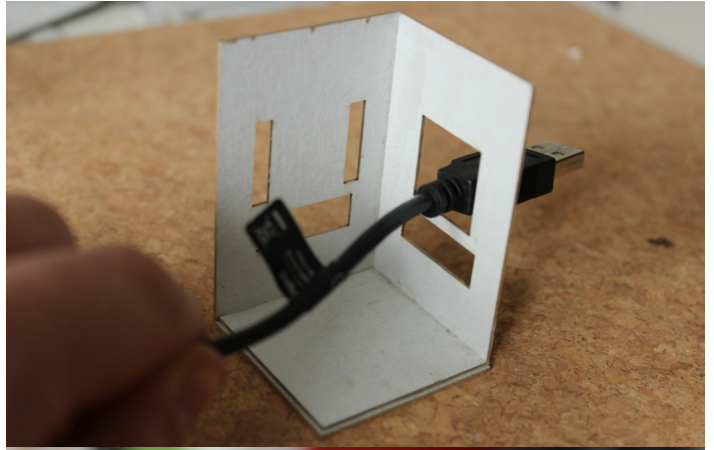
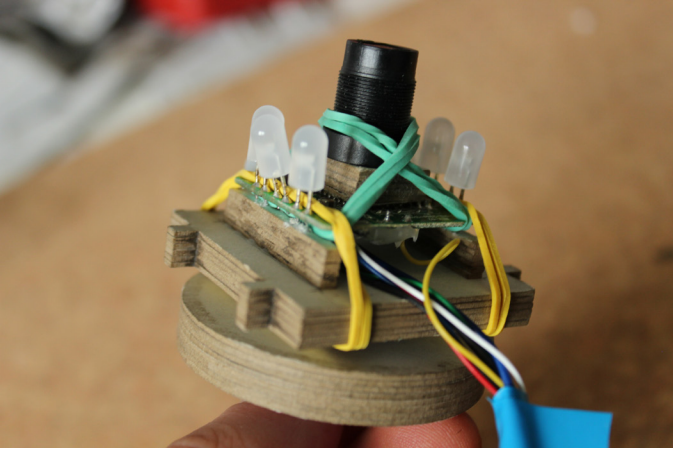
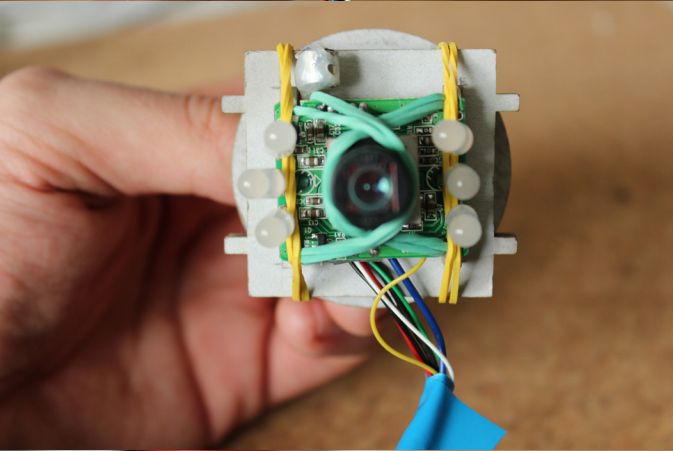
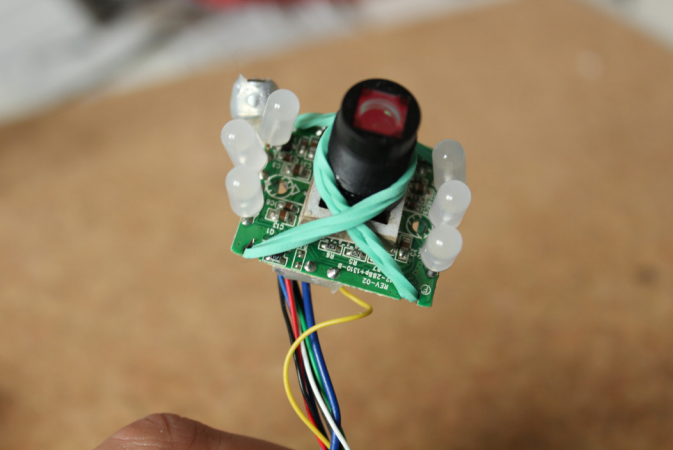
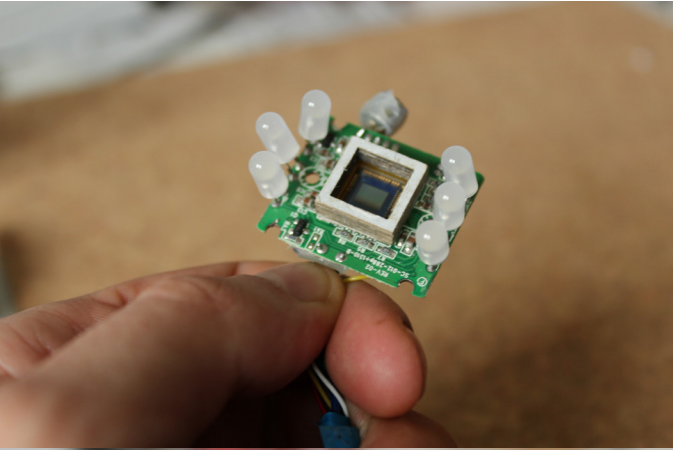


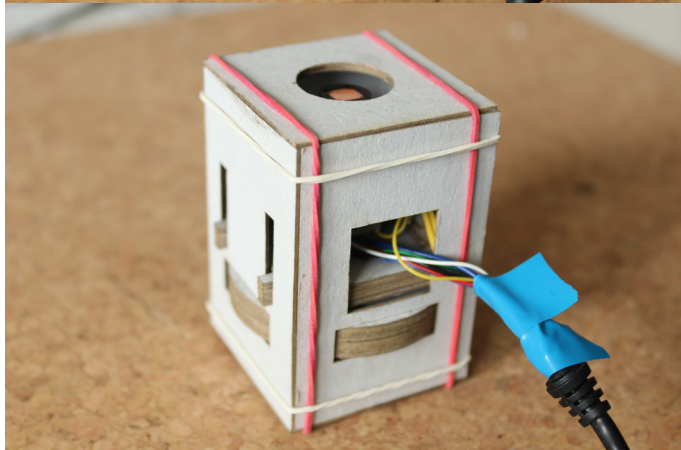
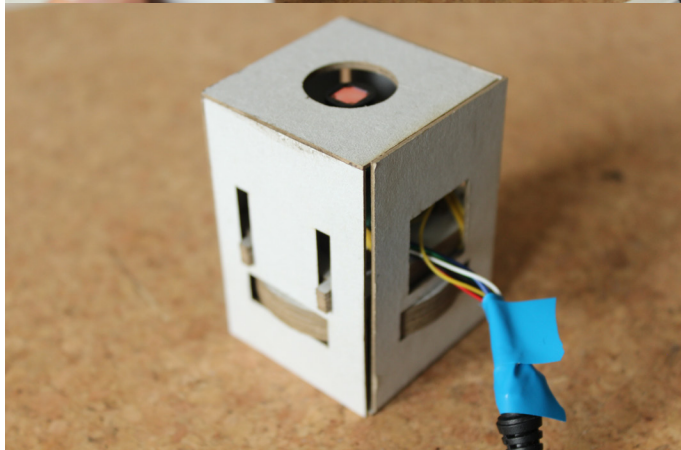
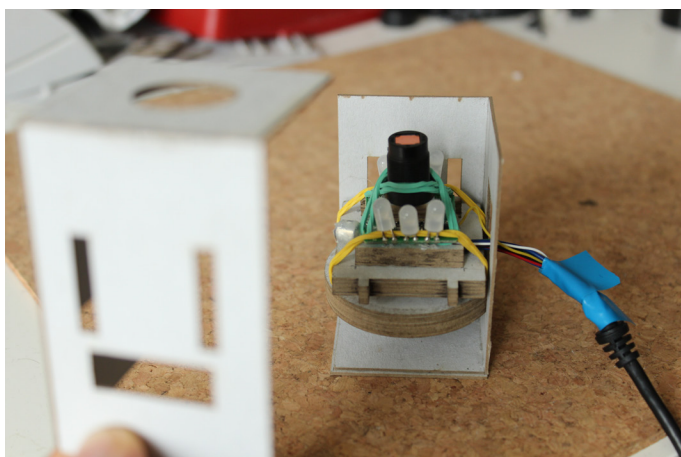
6. Take these ones and glue the suitable together. Then glue them on the top of the square from step 1.



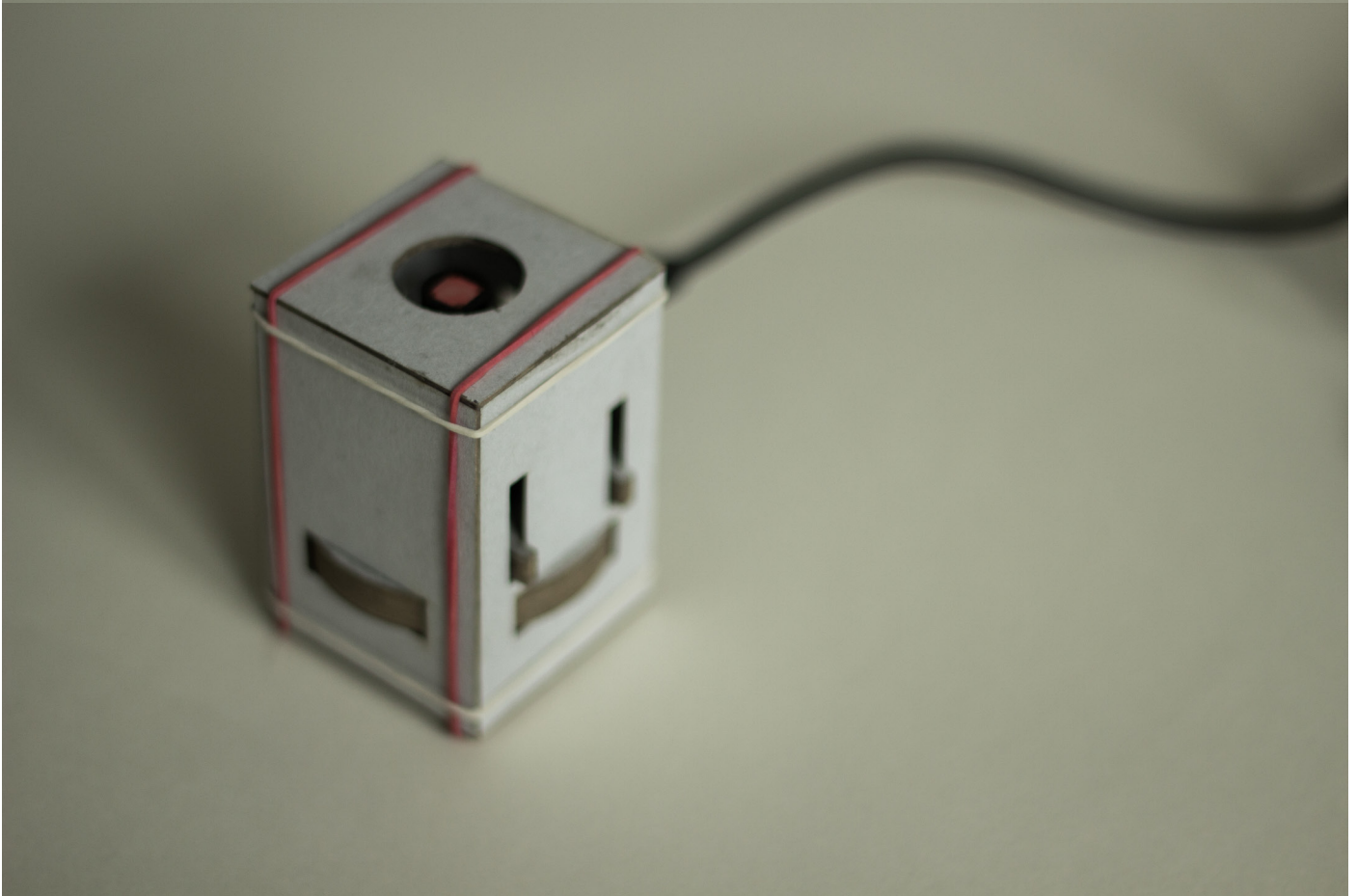
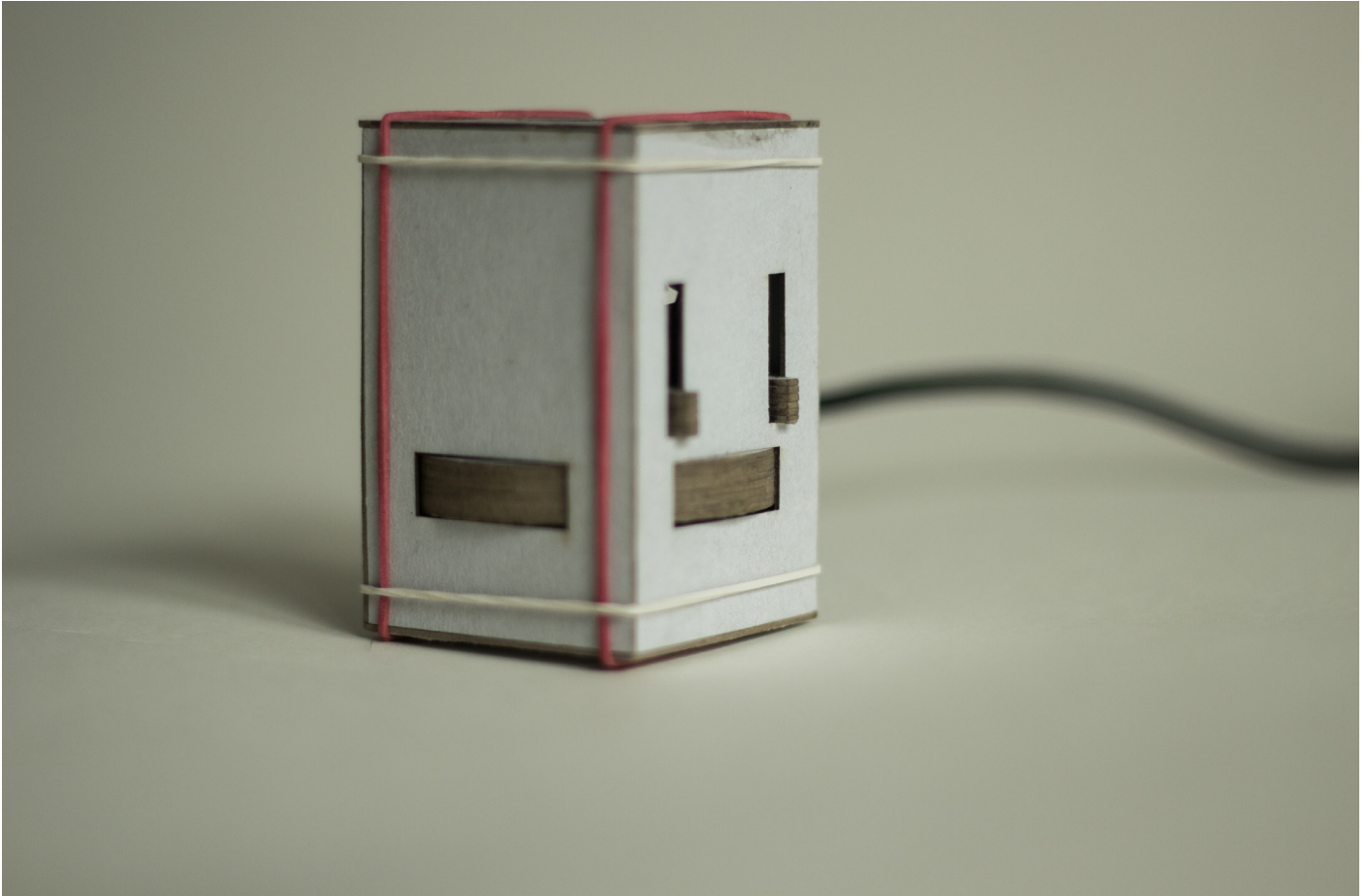
7. Take these ones and glue them together. The one with the small border is the one on the bottom. How many you put together is your decision. Try a little bit with them later, they are for the distance between lens and ccd.

8. Put everything together.





Finished



Evaluation

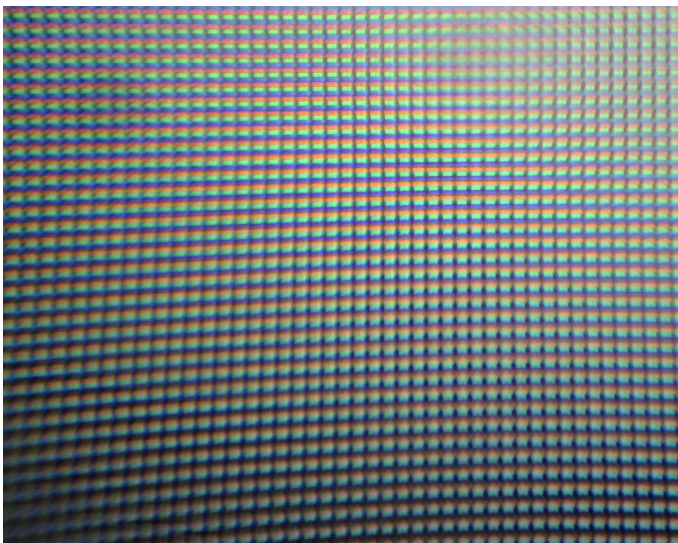
At first there is the question if the microscope fulfil the initial aim and I am very satisfied how well it works. The construction with the screw and the wheel is very precise and the possibility to combine light and dark field microscopy gives me a lot of opportunities to take images and videos.

I had a problem with my original web cam and had to buy a new one. It's almost the same but instead of the 640x480 pixel the new one has a resolution of 1280x1024 pixel. So the comparison with the other microscopes out of the class was difficult. It looked as if my pictures are not as close as the other ones are but it's more than 4 times as large.

In numbers the calculated magnification in class were that we were looking at a surface of 0,45 x 0,33 mm. So I did the same calculation just with another display.

HTC Desire: dimensions- 48x80 mm
resolution- 480x800 pixel

pixel density: 0,1 mm per pixel (10 pixels per mm)



48,6 x 38,5 pixel, so we look on a surface of 4,86 x 3,85 mm and the magnification is 26,3 times bigger than the physical size.



But I tried to make this better with enlarge the distance between lens and CCD. This picture is made with a 4 mm distance and you can see the difference. 24,2 x 19,3 pixel, so we look on a surface of 2,42 x 1,93 mm and the magnification is 52,9 times bigger than the physical size.

And this picture is made with a 9 mm distance which is almost the maximum because the lens almost abuts the object. 14,1 x 11,25 pixel, so we look on a surface of 1,41 x 1,125 mm and the magnification is 90,9 times bigger than the physical size.

If we now would take the 0,45 x 0,33 mm from the webcam with the smaller chip and multiply this with 4 to align it with the larger resolution it would be 1,8 x 1,32 mm. So my microscope may come a little bit closer, but because of the handling I did most of my pictures and captures just with 4mm distance between lens and CCD.

I thought that the bigger chip would mean also a better magnification, but I was wrong. In the end I was satisfied with the images but it took some time to test some distances.

What I did...

with the pictures and captures from my new microscope - **an interactive photo**

just using some basic knowledge of HTML, CSS and a little bit JavaScript. It's a kind of visual concept how you can proceed with the data. I was impressed how cheap and easy it was to build this little microscope. With around 20 € everyone can explore his tiny surrounding. So I had the idea to make a tour through my flat and have a detailed look on some stuff. Like in the old Point & Click Games you can decide by yourself where you want to have a look on. To start the website you just have to follow the link below. Search for the Manuel_Janke_microscopy_website.html and click through my flat.

https://www.dropbox.com/sh/4mdtr717egof9xc/d_qeKTd-LuN

(* If there is any problem with proper loading of the videos or other content, please download the whole Manuel_Janke_Webseite_DIY_Microscopy folder and start the site on your local harddrive. ** Google Chrome or Mozilla Firefox recommended)