

DIY – Microscopy

Introduction

Goal of the workshop was to repurpose a possible cheap USB webcam into a microscope. Max Neupert, the organizer of this workshop, told us how to achieve this and instructed us throughout the winter term 2012/13.

The basic concept Max told us is pretty simple: just disassemble the camera, mount the lens upside down and shoot some great photos with the new microscope.

Disassembling the Camera

The “Hama PC-Webcam AC-150” served as a basis, which costs about € 5 when ordering via Amazon. It has a resolution of 640x480 pixels and six LEDs to lighten the scene. Beyond this, the camera supports UVC (USB Video Class), which is important for viewing live images directly on the screen.

As mentioned before, the first step was to disassemble the camera. In the photo below one can see the original package and the camera without case in the front of it.



Image 1. The disassembled camera in front of the original package.

Next step was to remove the six LEDs. In order to do so, we had to heat the solder at the back side of the PCB (printed circuit board). Image 2 shows the camera and the removed LEDs in front of it.



Image 2. The camera and the removed LEDs.

The last important step was to mount the lens with hot glue upside down onto the PCB.

Building a Case

Since a microscope is designed to show very small objects, it is not appropriate to hold the camera in the hand because of uncontrollable hand movements. Therefore we needed to build a case that holds the microscope and gives the possibility to do little adjustments in height (that's our zoom).

My approach basically consists of two sleds that lie on one another where the contact surface is a plane in the angle of 15 degrees to the table. Pushing the lower carriage to the left will force the upper carriage to move upwards. Image 3 and Image 4 show both a technical side view drawing and a rendered image of the case I wanted to build.

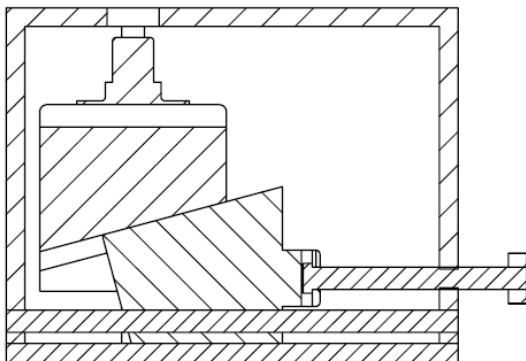


Image 3. Side view of the case.

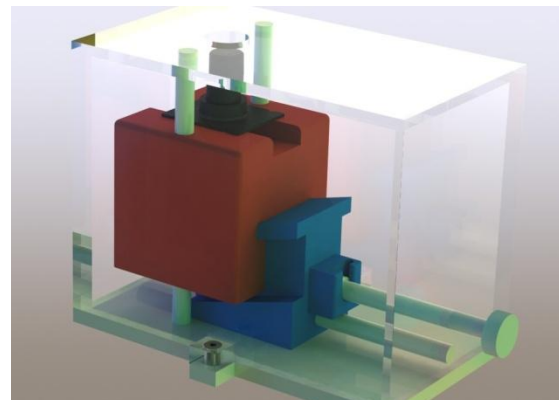


Image 4. Rendered image of the case.

After building a prototype out of Balsa wood, I was able to prove that the construction works fine.



Image 5. Case prototype (1).



Image 6. Case prototype (2).

Nevertheless, some minor changes to the model have been done before printing the parts with a RapMan 3D printer. In Image 7, that shows the two printed sleds carrying the microscope, one can notice that a M4 threaded rod was stuck through the lower sled and two counter nuts were fastened at each side of the sled, whereas one can see in Image 4 very clearly that a screw head should have lied in a little pocket.

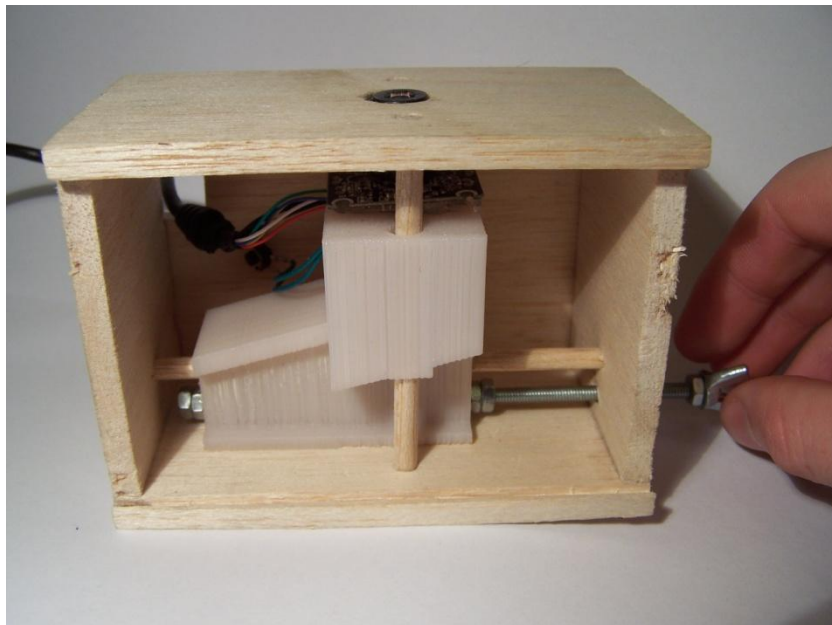


Image 7. The microscope mounted on the printed sleds. The case will be printed later.

M4 thread has a pitch of 0.7 mm, which means that one rotation about its own axis will move the lower sled 0.7 mm and therefore the upper sled about 0.2 mm. As a result, the microscope can be adjusted very fine in its height.

WebcamCapture Application

Because of the lack of simple applications which just show the current image of the webcam, I wrote a little program that does exactly this. Furthermore it allows you to save single images by pushing the

space bar, record videos by hitting R and give a useful suffix (such as “display” or “knife-edge”) to the filename by hitting N.

The application is available at the [Microscopy-Wiki](#), but note that the program only runs under Windows and [.NET Framework 4](#) has to be installed.

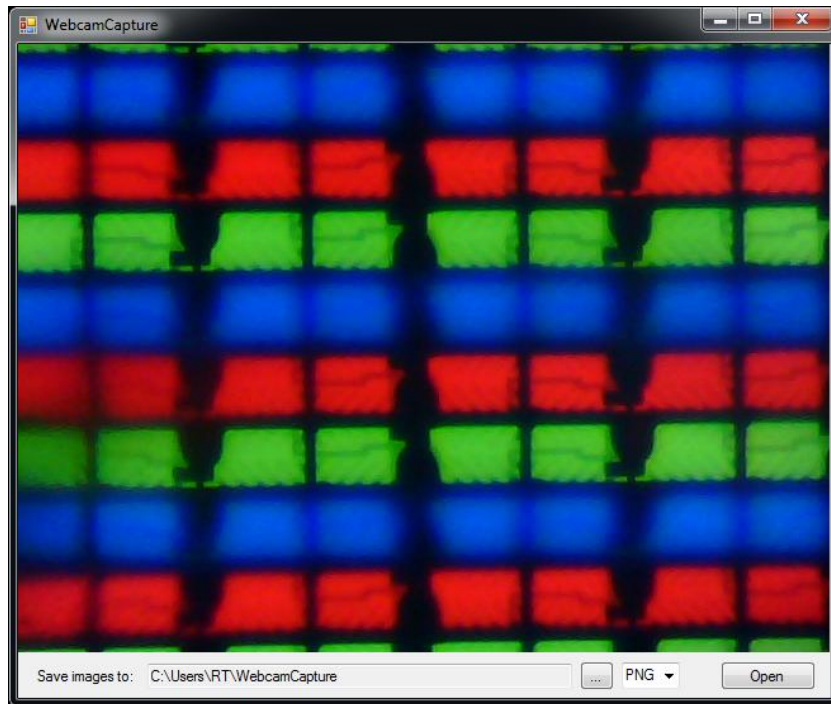


Image 8. Screenshot of my simple application.