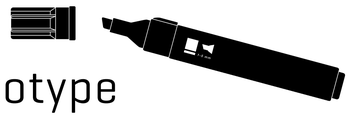
DIY Microscopy I / Field Guide

Microscopy is the technical field of using microscopes to view samples and objects that cannot be seen with the unaided eye (objects that are not within the resolution range of the normal eye). There are three well-known branches of microscopy: optical, electron, and scanning probe microscopy.

One Semester 2012/2013

CONCEPT PHASE



build prototype

Through a simple hack, every webcam can be turned into a digital microscope, allowing the magnified observation of life forms, analysis of biological motion and form, as well as audio-visual interpretations for aesthetic presentation. In order to build the best possible microscope it's important to follow a series of prototyping steps to make sure your design is functional and to discover any potential flaws in your design.

TECHNICAL DRAWING

This is the beginning point in which you will create your design concept and visualize your microscope. This drawing will also be the basis for determining specific measurements.

HACKING THE WEBCAM

In the elab we will dissassemble the webcam to reveal the lens and microchip. The lens must be removed, flipped 180° and glued back in place with a hot glue gun. You need to be very precise to keep your lens clean and dust free otherwise you will encounter imperfect imaging later on.

CARDBOARD MODEL

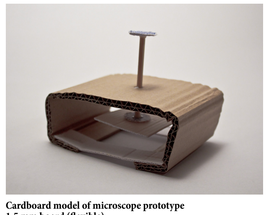
Creating a model in cardboard will help you avoid problems down the line. Visualizing the object and basic functionality in physical space helps you to discover engineering flaws. This phase also allows you to experiment with form and function. This model will help you to get precise measurements for your 3D model.

3D MODELING

Start with a basic 3D modeling software such as SketchUp or Blender to create a virtual model with precise measurements. It's important to create an accurate 3D model in order to test the functionality and design.

>> Don't Forget: The field of depth is only between 1.8 mm and 3mm.>>

Disassembling of the webcam housing



Cardboard model of microscope prototype
1.5 mm board (flexible)

>> It is recommended to choose a webcam that isn't only working on one platform. A good choice is a USB Video Class compliant (short: UVC) camera.>>

DEVELOPMENT

build microscope

There are many ways to build a microscope using the data you collected in the prototyping phase. It is important to consider how your microscope will be used when choosing your production method and materials - in a studio environment or as a VJ-ing tool, visualizing microorganisms for a live performance? The more precise you can be with your design the easier it will be to build a solid construction.

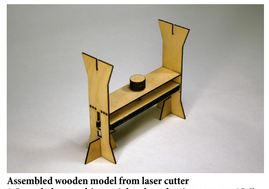
LASER CUT

You can create all of your parts in 2D for a laser cutter. You will use the measurements from your 3D model to create your model in Illustrator and then create a file for the laser cutter. The laser cutter can cut your pieces out of balsa wood (up to 1.5mm thick) or plexiglass (up to 3mm thick). The final pieces can be assembled and glued together like puzzle pieces.

Assembling laser cut model in studio

3D PRINTING

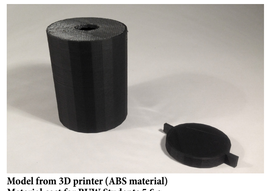
If you plan to use the 3D printer you will need to export your 3D file as a STL. In order to work with Rapman 3D printer you need to export STL files via Sketchup. Then use Skeinforge to create BFB for the 3D printer. Consider that based on the size, complexity and thickness of your model the printing process can take a considerable amount of time and you should prepare for that when you schedule time on the printer.



Assembled wooden model from laser cutter
1.5 mm balsa wood (material and production cost app.15 €)

FINISHING

Objects from the 3D printer have imperfections and require some general sanding and sometimes in individual cases some drilling or glueing.



Model from 3D printer (ABS material)
Material cost for BUW Students 5 € +

Data from the printer >>Rap Man 3D printer<<
Extruder
Build time is 8 hours 37 minutes 36 seconds.
Distance extruded is 732463.7 mm.
Distance traveled is 754795.5 mm.
Extruder speed is 255.0
Extruder was extruding 97.0 percent of the time.
Extruder was toggled 3820 times.
Operating flow rate is 2.5 mm3/s.
Feed rate average is 24.3 mm/s, (1458.3 mm/min).

FORM & STYLE

First, consider good design as being the minimum necessary. The phrase "more is less" is a good mantra to abide by. Clever designers will figure out the best way to maximise the use of materials and processes they undergo.

Look carefully at your design, is there anything that could be considered superfluous? Is there anything that if you took it away, nobody would miss it terribly?

SCIENCE & ART

drawing with light

In this phase you move from the engineering phase into the field of science and art. To begin your scientific investigations you need to start collecting raw materials to view under the microscope. This could include a visit to the grocery store, contacting laboratories, pharmacies, pet shops or visiting outdoor locations to find materials with relevant microscopic potential.

COLLECTING

When you begin to collect samples to look at under the microscope you will want to chooose a variety of materials to discover which items have the best microscopic qualities. You may consider itmes such as rotting water from flower vases at the cemetery, onion skin and dirt.

FIELDTRIP

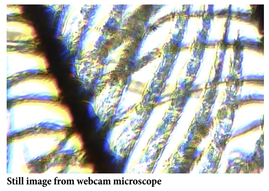
A group fieldtrip is a helpful way to inspire new ideas and to start conversations with your collegues. Choose a location like the Optical Museum Jena that relates to the microscopy subject. The Optical Museum has optical instruments on display from eight centuries and provides a technical and cultural-historical survey of their development. The history of the city of Jena as it rises to the centre of the optical industries since the mid-19th-century is integrated in the exhibition, connected with the lifeworks of Ernst Abbe, Carl Zeiss and Otto Schott.

optischesmuseum.de

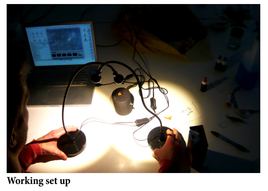
COLABORATION & INTERACTION

Collaboration and interaction with classmates can improve your project in unexpected ways. Two different working methods or style approaches can be combined. While capturing footage of different specimens you should try brainstorming, playing with images, sounds, and sketching these visualisations into a journal for later reference. Combining topics and techniques from different art practices can be a great opportunity to form a new artistic approach.

>> The coining of the word "Photography" has been attributed in 1839 to Sir John Herschel based on the Greek (phos), meaning "light", and (graphê), meaning "drawing, writing", together meaning "drawing with light".>>



Still image from webcam microscope



Working set up

CONCLUSION

final project

Once the research and experimentation phases are complete it's time to produce a final project. Scientists have already produced beautiful microscopic images but as an artist it's our goal to discover something unique and new with these materials as a starting point. The end results can range from video art, printed materials, or even audio controlled by the movement of microscopic organisms.

IMPLEMENTATION

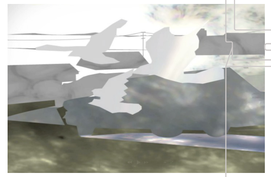
Organize your source material. Are you using pre-recorded material or preparing your setup to use the DIY Webcam Microscope as a VJ-ing tool?

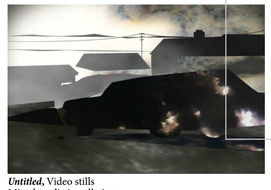
FINAL EDITING

If you are working with static images or prepared footage you will need to develop this into a final working format. You may want to use After Effects or different video editing software to prepare your video material. This could be combined with vector images from Illustrator. If you are working with a real-time process, such as visualizing microorganisms using something like water based organisms to process the visuals, you should create a short video of the process.

DOCUMENTATION

The documentation process is something you should consider on day one of the project. Once you have completed your project the documentation will provide a full context of the process. Final documentation can range from an illustrated journal, online wiki entries, a video documentary or other types of publication. The main purpose of the documentation is to communicate with others about your project but it will also serve as a reminder for yourself about the various techniques and materials you used along the way.





Untitled, Video stills
Mixed media installation
Video, sound, loop (1:54:36)
Amel Ali-Bey & Nils Andersen

>> We started by focusing on aesthetical aspects and the idea to combine a micro and macro world.>>

Amel Ali-Bey and Nils Andersen in their final presentation

percentage of time spent

40% concept phase	20% developement	15% science & art	25% conclusion