Trainers for Visually Impaired Students Introduce 3D Printing

Guideline

Improving accessibility of 3D printer for visually impaired user

Document for the T4VIS-In3D trainer course

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Content

1 General

This guide is intended to give trainers advice on how to enable participants with visual impairments to operate various 3D printers. Care is taken not to make any structural changes to the machines that would limit their functionality or warranty. Likewise, care is taken to make as few adjustments to the devices as possible, or to demonstrate solutions with little effort.

Since the technical development of 3D printers will also make significant progress in terms of user-friendliness, these recommendations refer to the generation of machines that will be used in the project.

2 Adaptation Hard- and SoftwareBasics

2.1 Basics

FDM printers used in the commercial sector usually have a closed housing or a modular enclosure. This allows frontal access to the installation space via a door or hatch. Accidental access to the installation area and the moving and heated components is therefore largely impossible.

Enclosures or housings made of acrylic glass can cause reflexes in certain eye disorders. The use of edge-filter goggles could partly provide a remedy here.

In many cases, the operation of the devices by the target group can be made more difficult because the contrasts between the assemblies, operating elements and materials are too weak. These problems can in many cases be remedied by simple solutions and better lighting.

1.1 Device displays

FDM printers usually have an LCD display built into the device for operating purposes. The display size, colour and contrast of the display vary widely. Some manufacturers offer an adjustment of the display brightness via the system menu.

Figure 1 Monochrome display of Ultimaker 3 Extended

Figure 2 Colour display of Rise3D Pro2

In some cases, the display may still be too small and/or lacking in contrast despite adjustment options.

The use of table magnifiers can offer a simple but effective solution here. Inexpensive table magnifiers can be found in the DIY sector for soldering or handicraft work. These magnifiers are adjustable over several axes and, despite their low purchase price, have the necessary stability.

Figure 3 Using a table magnifier to read the display

For professional printers, operation via the display is often not absolutely necessary, as extensive operation via a workstation computer is possible via LAN or WLAN. Ultimaker also offers an app for iOS and Android smartphones and tablets. Operation via computer or mobile device can thus be much easier for machine operators with visual impairments.
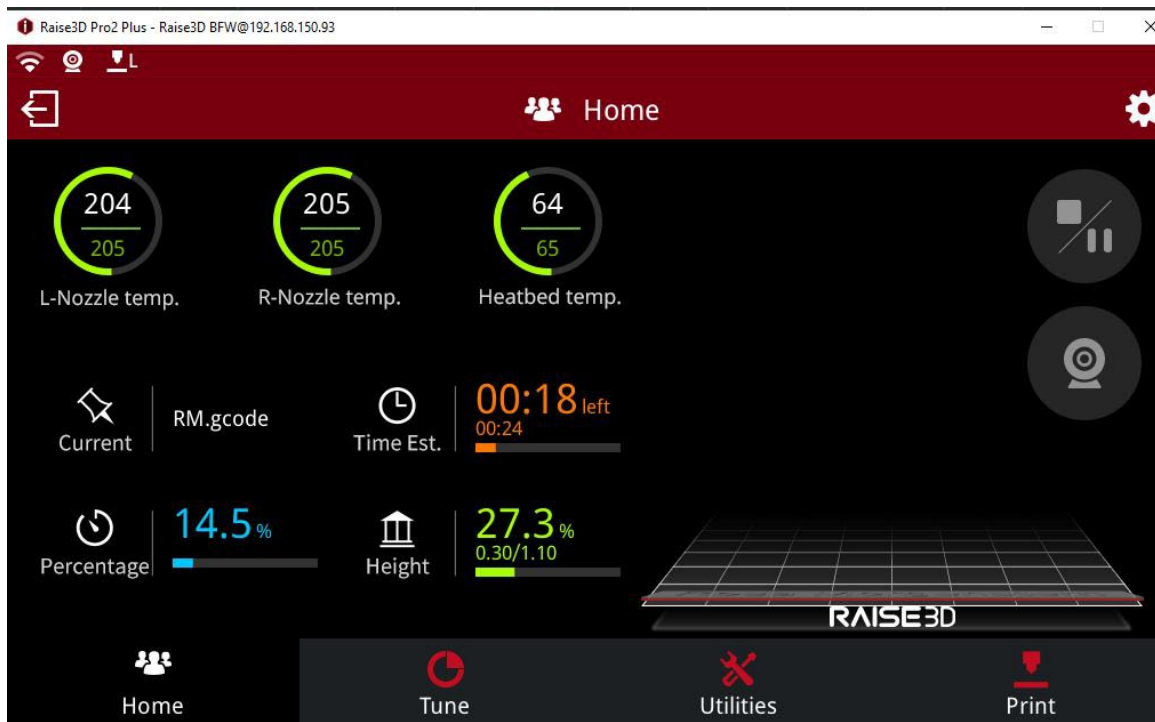
Figure 4 IdeaMaker software for online control of the Raise3D printer
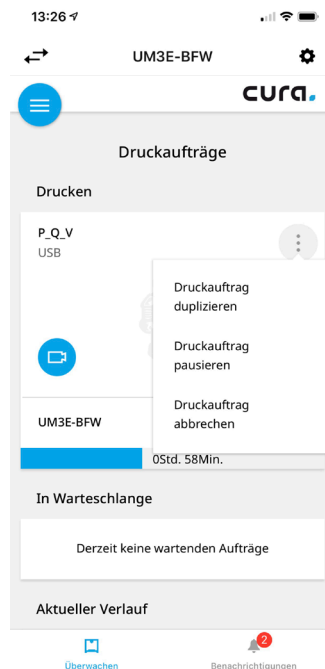

Figure 5 Ultimaker smartphone app for operating the 3D printers

![T4VIS 3D logo]

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## 1.2 Examples of contrast enhancement of the components

1.2.1 Build Plate/Print Bed

The contrast of the print bed can cause problems in various operations.

1. when levelling/adjusting the distance between the nozzles
2. when assessing the print result of the first layers
3. when removing small or delicate components

1.2.1.1 Levelling the print bed

Although modern 3D FDM printers have an automatic levelling function, a basic adjustment must be made during the first start-up or after transport. The operator must use a feeler gauge to set the distance between the extruder nozzle and the print bed. Ideally, this is done by looking at the extruder at the height of the print bed. Depending on the colour of the housing, this can cause difficulties when carrying out and recognising the feeler gauge. This can also be remedied in a simple way.
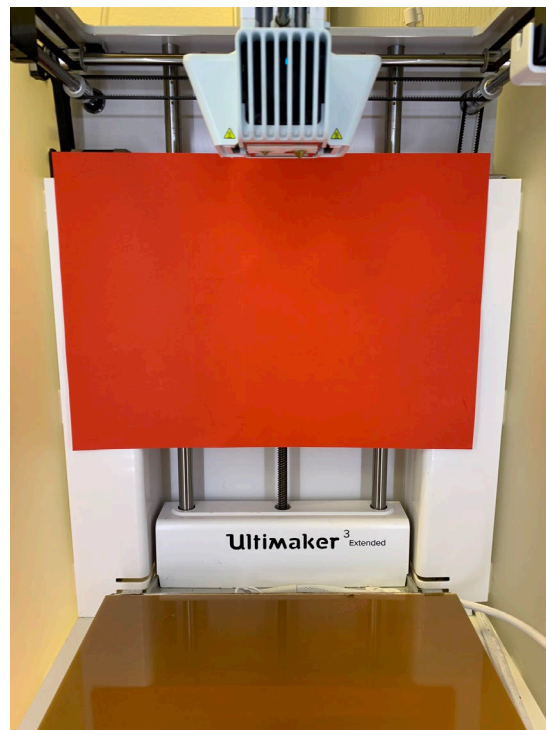
Figure 6 Increase contrast with coloured cardboard

By attaching a coloured cardboard to the rear, the contrast can be increased according to the operator's requirements. If necessary, a narrow strip can also be placed on the print bed behind the extruder.

![T4VIS 3D logo]

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1.2.1.2 Assessment of the print result and removal of the components

For unheated print beds, glass is usually chosen as the material for the print bed. This can easily be covered with adhesive tape or 3M "Scotch Blue Tape" masking tape to strengthen adhesion. The latter provides good contrast against most filament colours (except blue). This makes it possible to assess the printing result and the model body. However, loosening the components requires spatula and a certain amount of force.

Industrial 3D printers usually use a heated print bed. The surfaces are very different and can be made of glass, aluminium or coated aluminium/metal.

With uncoated materials, the print bed can also be covered with the above-mentioned Bluetape or beige Kapton tape to improve adhesion. Here, too, it is necessary to loosen the components with tools.
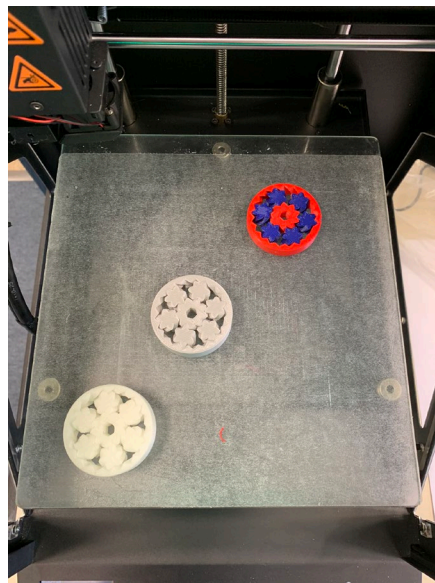
Figure 7 Unheated print bed made of glass with low contrast

A good alternative for improving adhesion performance, especially with materials that require higher temperatures, is offered by permanent printing plate made of plastic. With these pads, the components release automatically as soon as the temperature of the printing plate sinks below 27°C. In addition, they offer a good contrast to the common main colours.
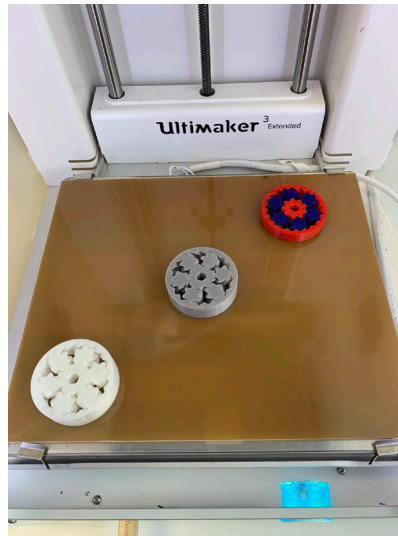
Figure 8 Permanent printing plate with increased contrast

By procuring the printing plates, you also offer the advantage that the bottom side of the models is smooth. The solubility of the material also means that accidental damage can be avoided.
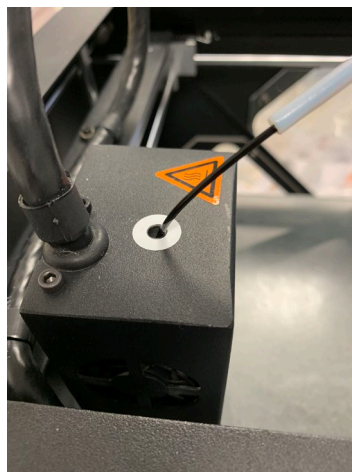
1.2.2 Filament guidance

With some extruders, the feeding of the filament is not mechanically controlled. In these cases, the feeding of the filament can be difficult in case of visual impairment and depending on the colour design of the extruder housing.

Figure 9 Filament feed without marking

Here, simple tools can also be used to provide assistance. The filament guide can be marked by coloured markings, e.g.: by hole enhancers.

Figure 10 High contrast marking of the filament guide

2 List of figures