Lego Toys with Leocad

Brick for Brick

Lego on a PC? That might not sound much of a hands-on experience, but Leocad does allow you to create Lego models and construction plans on your PC. As well as the Windows version there is a slightly restricted Linux version which we tested on a 750 MHz AMD Duron with 128 Mbytes of RAM and on a 133 MHz Intel Pentium I with 32 Mbytes of RAM.

The program ran on both systems – a powerful video adapter and an X server to match are the most important hardware features to look for. Without these, the images take ages to display and it is almost impossible to use the program.

Leocad requires **OpenGL**. If you see the *OpenGL not supported* message when you launch the program, you will need to install this feature from your distribution CD. If you still experience problems after this step, refer to Box 2 where you will find a workaround.

Thanks to pre-configured **binaries** installing the Lego modeller should be child's play: You simply download the *leocad-0.73-update.tar.gz* archive from the program website *www.leocad.org* [1] or from the CD included on the subscription disc and ensure that you are the *root* user in order to expand the archive in */usr/local/bin*. This places the *leocad* executable in */usr/local/bin/leocad-0.73*. You can use

```
ln -s /usr/local/bin/leocad-0.2
73/leocad /usr/local/bin/leocad
```

to create a **link** to the program in a directory included in your **path**. This step will save you entering the complete path each time you launch the program.

You will also need the *pieces.zip* file, which is also available on the Leocad homepage or the subscription CD. The file contains descriptions of Lego building blocks. Use the *unzip* tool to unzip this file in */usr/local/share/leocad*. You should now drop your root privileges and launch the program by typing *leocad &* at the console.

You've heard of them – everybody has – those little plastic bricks with lumpy bits on top that you can use to build amazing houses, cars, ships and trains. Now Leocad allows you to construct Lego models on screen.

BY FRANK WIEDUWILT

If you intend to compile the program from the **source code**, you will need to download the current version from **CVS**. Box 1 shows you how to do so.

In the beginning... there were bricks

When you launch Leocad you will see something similar to Figure 1 with the main menu and toolbars at the top, the drawing window on the lower left, and the selection list for the individual lego bricks to the right.

For easier viewing you may want to display a grid on the drawing area, this will help you keep your bearings while compiling the model. To do so, select *View / Preferences* in the menu. Then in the configuration dialog that appears

click on the *Drawing Aids* tab and enable the *Base Grid* option; keep the grid size for the time being.

The *Axis Icon* option in the same tab is also useful. When enabled, this function displays the coordinates in the lower left corner of the drawing, and this clearly shows the current directions of the X, Y, and Z axes.

To place a brick in the model, you must first select the required element in the component list and then select *Piece / Insert* in the menu. The mouse cursor changes to a small cross, and you can then click, or press the [Ins] key to place the brick in the drawing. You can use the arrow keys, or [Page Up] and [Page Down] to position the element. The arrow keys move the brick in the

horizontal plane, [Page Up] moves the brick up and [Page Down] moves it down. The current position of the selected element is displayed in the status line.

You can use the keyboard shortcuts [Ctrl + Page Up] and [Ctrl + Page Down] to rotate a selected brick (i.e. a brick with a blue frame surrounding it) about its vertical axis. [Ctrl] an arrow key rotates a brick about its horizontal axis. Table 1 provides an overview of the keyboard shortcuts used for moving bricks.

To select several bricks, keep the [Shift] key pressed while selecting. To avoid splitting up units, you can group elements by selecting *Piece / Group*.

The array function helps you clone several bricks on top of or next to one another. Just select the brick you want to duplicate in your draft and call the dialog box by selecting *Piece / Array*.

Use the *Count* field under *Dimensions* to define the number of new bricks to create. Use *Move* under *Transformation* to decide the number of units to place the new bricks by relative to the last brick. Use Rotate to enter a rotation angle for the bricks.

New Lego People

When you are building Lego people, Leocad helps you out with the *Minifig Wizard* (Figure 2), allowing you to create the character from individual pieces, where each piece can be assigned

individual color. You can choose the required elements from a list and use the color button to define their colors. To save a design, type a name in the list on the lower left and then click on *Save*. If you want to change your design later, you simply select its name from the list.

Step by Step

This procedure will take you closer to your construction goals, brick by brick. To ensure that actually building the

Figure 1: Leocad

Figure 2: Compiling a figure

Box 1: Source Code via CVS

Unfortunately, the Leocad homepage does not provide a source code archive that users can download. Instead, you will need to download the source code from the CVS repository at *gerf.org*. Assuming that you are online, you can use the following CVS syntax to do so:

```
cvs -z3 -d :pserver:guest@gerf.↵
org:/usr/cvsroot login
```

(Use *guest* as your password).

```
cvs -z3 -d :pserver:guest@gerf.↵
org:/usr/cvsroot checkout -r ↵
leocad-0-73 leocad
```

After checking out the sources you can change to the source code directory and start compiling the program by typing *make*. Finally, copy the executable *leocad* to a directory of your choice.
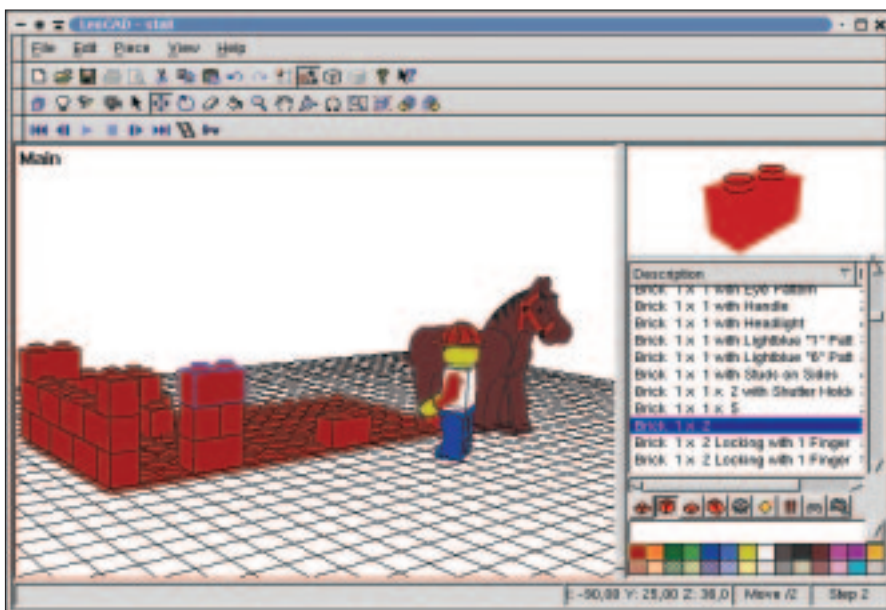
GLOSSARY

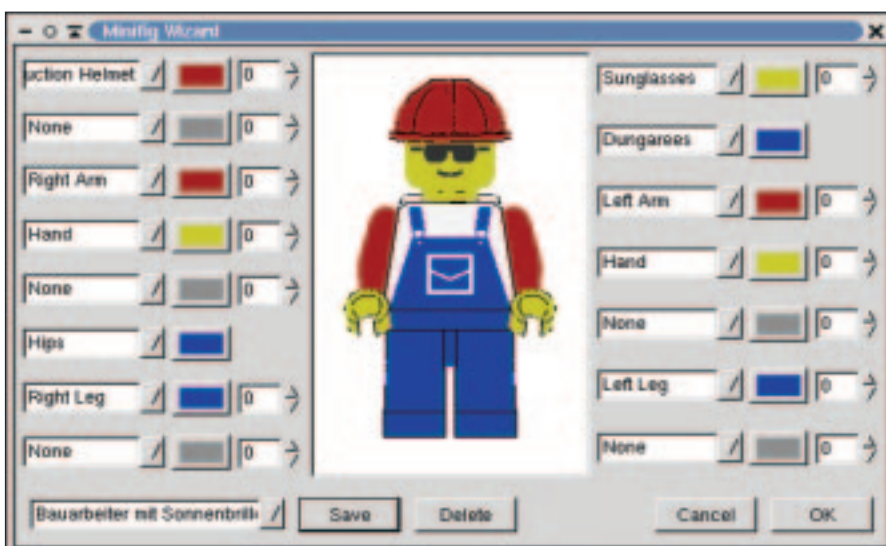**OpenGL:** *A library for displaying and manipulating three-dimensional graphic objects.*

Binary: *An executable program.*

Link: *A reference to a file or directory or in other words, a second name by which you can call a file or directory.*

Path: *The PATH environment variable comprises the directories where the operating system will search for programs or scripts without the user needing to supply the complete path.*

Source code: *A collection of instructions in a programming language that need to be translated by the computer (in the case of compiler languages) in order for the operating system to run them.*

CVS: *The "Concurrent Versions System" is a source code management tool for managing code simultaneously authored by multiple programmers. CVS ensures that all the staff working on a project are using the same version of the source code. You can also extract older source code versions from the CVS repository.*

model will be easier in real life, you can record the construction steps for the model in single steps and replay these steps later. The toolbar at the bottom of the screen contains commands for saving and replaying the building steps.

After each step that you would like to record simply click on the right arrow symbol. The number of the current construction step is incremented and displayed in the status line to the right of the *Step* keyword. If you want to run through the construction steps for the model, just step through your design by clicking on the buttons.

Points of View

There are seven different camera positions that allow you to view the model from various perspectives. Choose *View / Cameras* to access these options. You can also open several views of the same model at the same time. *View / Viewports* offers a selection of various view modes.

The large window shows you the view from the main camera, and the smaller windows show you front, rear and top views of the model (Figure 3). You can use any of these windows for construction tasks – your changes are displayed in all the views. However, working with more than two views of a model does tend to impact performance.

Background Scenes

If the white background gets too boring for you, you can apply a new background to your current scene via the "*View Preferences*" dialog box in the *Scene* menu.
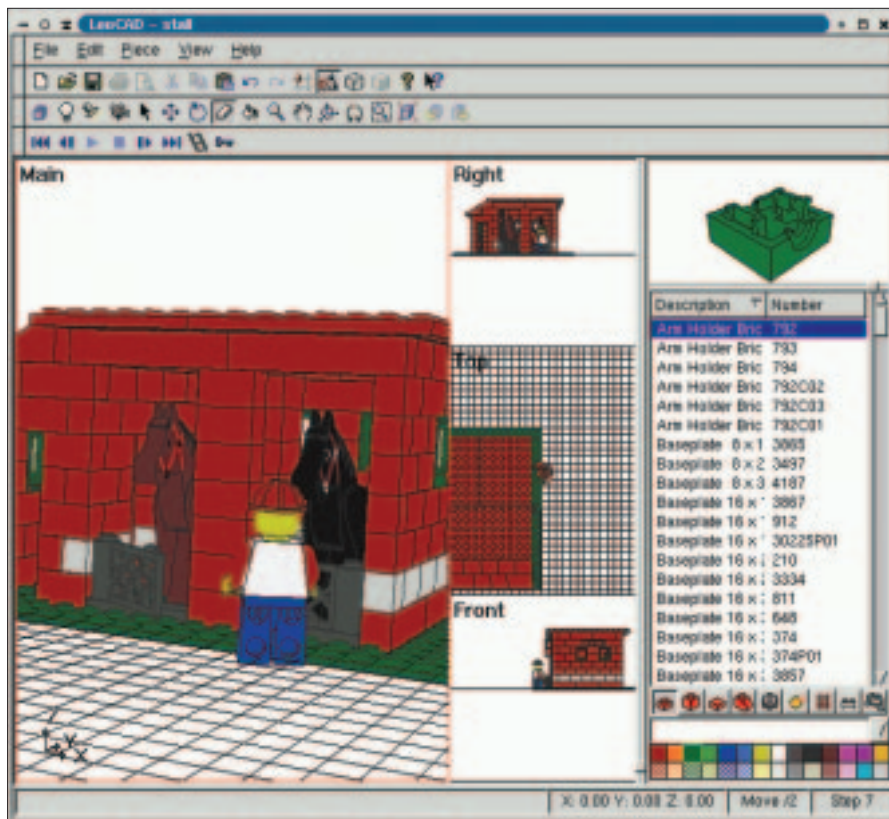

Figure 3: Multiple Views of a Model

Use *Solid color* under *Background* to select a single color for the background. *Gradient* allows you to create a color gradient from top to bottom, where you can choose the top and bottom colors via the left and right buttons. The Image option even allows you to use a picture for the background.

The *Environment* area allows you to inject *Fog* into the picture – the fog will become more dense as it approaches the background. Choose *Draw floor* to use a solid green background. Figure 4 shows you a scene with color gradient and light mist. The option *Ambient light* is also important, allowing you

to choose the color for highlighting. The brighter the tone you select, the more intense the lighting that Leocad applies to the scene.

Construction Plans for the WWW

To exchange models and construction plans with other Leocad users, you can export your plan to a series of **HTML** files that document the construction steps for your model one by one. To do so, select *File / Export / HTML*.

The *Layout* option in the dialog box shown in Figure 5 allows you to decide whether to show all your construction steps on a *Single page*, or (*One step per page*) instead. *Pieces list* allows you to define whether the element list will be

Box 2: Possible Issues with OpenGL

Leocad refused to work on the Mandrake 8.1 system we were using for our test, issuing the *OpenGL not supported* error message instead. To resolve this issue you might like to install the latest version of the OpenGL library *Mesa 3D*, which is available from the mesa website [2] or from the subscription CD, in the archive file *MesaLib-4.0.3.tar.gz*.

Use the *tar -xzvf MesaLib-4.0.3.tar.gz* to unzip the file and then changed to the newly *Mesa-4.0.3* directory where you can start to create the program using the *./configure* and *make* commands. Finally, ensure that you have *root* privileges in order to install the library to */usr/local/lib* using *make install*.

To ensure that Leocad can access the library you will need to edit */etc/ld.so.conf* so that */usr/local/lib* is at the top. Finally, as you are still working as *root*, you will want to call */sbin/ldconfig* and drop your *root* privileges.

Table 1: Important keyboard shortcuts for moving bricks

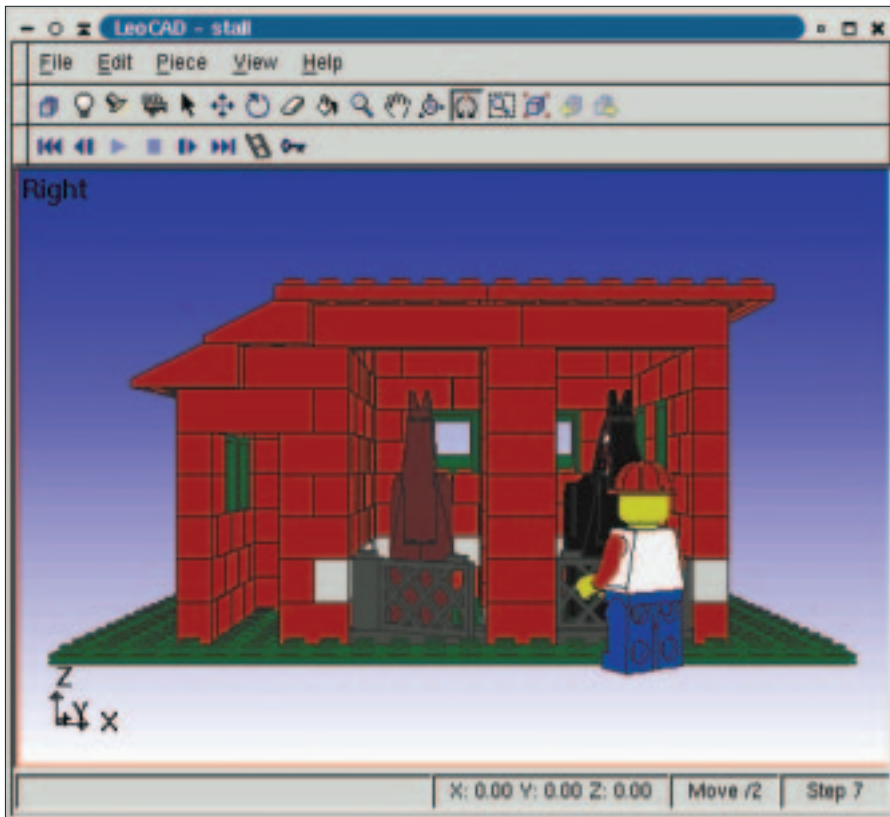| Action	Key (board shortcut)
Move a brick along the X axis	[Left Arrow]/[Right Arrow]
Move a brick along the Y axis	[Up Arrow]/[Down Arrow]
Move a brick along the Z axis	[Page Up]/[Page Down]
Rotate a brick about its X axis	[Shift-Left Arrow]/[Shift-Right Arrow]
Rotate a brick about its Y axis	[Shift-Up Arrow]/[Shift-Down Arrow]
Rotate a brick about its Z axis	[Ctrl-Page Up]/[Ctrl-Page Down]

Figure 4: Scene with Colored Background

Figure 5: HTML Export

Figure 6: HTML Export Options – defining Image Formats

Figure 7: Export Options for Povray

output *After each step* or *At the end*. Enter the directory where you want to store the construction plan in the Output directory field. The path must end in a forward slash – if not, the program will store the files in the wrong directory. Click on the *Images…* button to open a dialog box where you can define the format for your graphics (Figure 6).

Nice View

Although the 3D view in Leocad is quite appealing, the models do not look realistic. Fortunately you can render your models with a little help from *Povray*. Besides the raytracer you will also require the *lgeo* library, which is available from *www.el-lutzo.de* [3] or on the subscription CD. Use the *unzip lgeo.zip* command to unzip the file in a directory of your choice – you will need write access. When you select *File / Export / Pov-Ray*, Leocad opens a dialog box where you can enter the path to the

Lgeo library and Povray, and type a file name for the Povray file you want to create (Figure 7). It is a good idea to save your Povray files in the same directory as Lgeo, since the raytracer may not be able to find the elements it needs to integrate.

Due to a few errors in Lgeo you will not be able to use the brand new Povray Version 3.5. to render models. However, rendering should be no problem with the Povray 3.1 Version. The raytracer will display a few warnings, but nothing more serious. To really appreciate the realistic three-dimensional scene, you will need to open the Povray file with a suitable Povray front end, such as *peflp*.

Why bother?

If you enjoyed playing with Lego as a child, you will find it hard to escape from the fascination of designing Lego constructions on your PC. Leocad is extremely addictive! Unfortunately, the Linux version is not quite up to par with the Windows version, which is currently better maintained and at a later development stage.

You can use the program on older computers, provided they have a 3D accelerator card, a suitable X server and
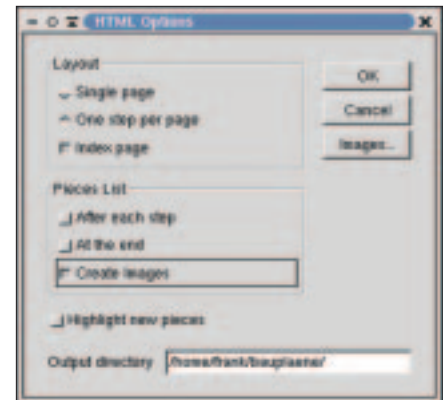
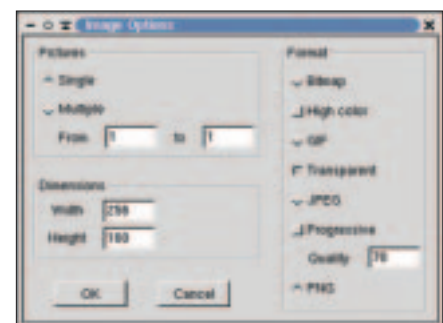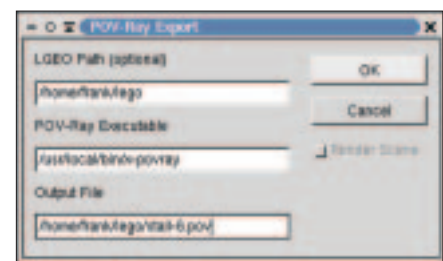enough main memory, but to create models with thousands of components you will need state of the art hardware. There are also some stability issues connected to OpenGL and nVIDIA graphics chips that might spoil your fun, if you have the wrong hardware.

Unfortunately, documentation is a different matter: The program is supplied without online help, and only a short tutorial is available from the Leocad website [4]. ∎

GLOSSARY

HTML: *The "Hypertext Markup Language" is the language World Wide Web pages are written in.*

INFO

[1] *http://www.leocad.org/*

[2] *http://www.mesa3d.org/*

[3] *http://www.el-lutzo.de/lego/zips/lgeo.zip*

[4] *http://www.leocad.org/tutorial/basic.htm*