LDD to POV-Ray Converter

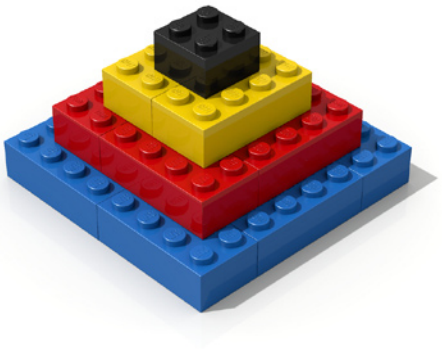
By Martin Hronský y Johan Sahlström

What is real these days?

This was a headline announcing the release of the LDD to POV-Ray™ Converter at the beginning of August 2012 on the Eurobricks(EB)frontpage. LDD to POV-Ray Converter is the first tool that allows you to create photorealistic renderings of the LEGO® Digital Designer models using POV-Ray™.

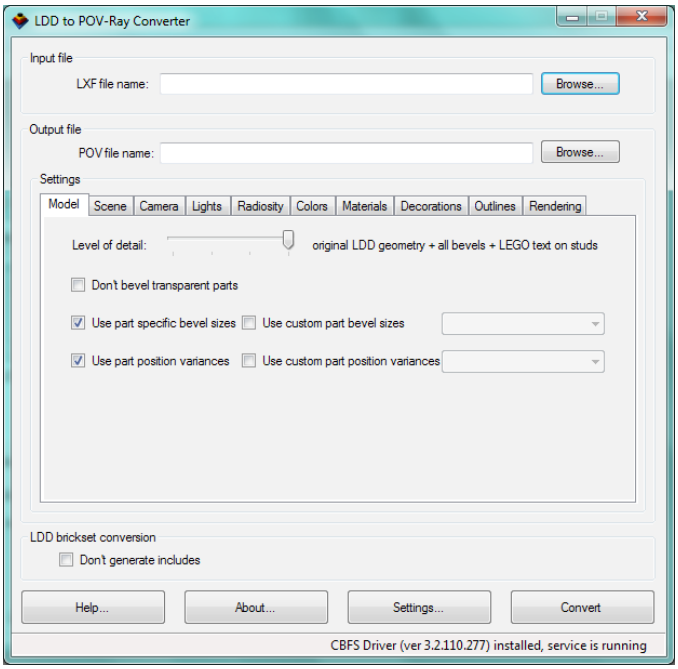
First steps

The whole story began about a year ago, in August 2011. LDD has been well known among LEGO®enthusiasts for many years. Also POV-Ray™ is not new to the fans of digital design using LDRAW based tools. However, LDD users have a little handicap – LDD is easy to use but it is not supported by any other software. Models can be exported only to LDRAW, and with mixed results since the mapping between the system is not always optimal. I have seen many requests for a conversion to other 3D formats. There are some tricks based on grabbing 3D data from a graphics card driver, but these are not for everybody and I wanted a solution suitable for everybody – legal and simple to use. Since I am a professional programmer and I like programming, it looked to me like an ideal task – joining two of my hobbies – LEGO® and programming.
So I started discussions with long time LDD user Johan Sahlström(on EB known as Superkalle) – what legal possibilities we have, or what can be published. LDD EULA does not permit derivative works and we wanted a legal solution. Originally, I did not want to stick to POV-Ray™ - target format was not important to me. Taking into account that POV-Ray™ is free and has been already known to LDRAW users, I also tried it.
The very first version of LDD to POV-Ray™ was just a set of scripts, xslt transformations and small C++ program for reading the data from LDD. Applying a trial and error approach I finally got the first large render - one of the official LEGO® sets - 7744 Police Headquarters. I shared the pictures with Johan. It was a great pleasure to work with him. With all his experience and sense for a detail the tool got much further than I had expected at the beginning. I still remember how surprised I was when he asked me a question about brick bevels. I did not even notice before that bricks are not mathematically square and edges must be beveled to make it look realistic. After studying our possibilities of adding bevels to bricks without manually editing each of 2500+ bricks supported by the LDD, the small pyramid, which is currently LDD to POV-Ray™ Converter icon, was the first LDD model with the full level of details – bevels and LEGO® logo on studs. I had seen this pyramid rendered on Friedrich A. Lohmueller's website and I wanted to make a picture of a similar quality.



A deal with the LDD Team

In the meantime, we asked the LDD team at LEGO® about possibility to publish a tool like LDD to POV-Ray™ Converter. We said that we would not publish brick geometry data or any other data which were not published by LDD. This seemed to be a completely unrealistic goal, since POV-Ray™ uses plain text files. How to store something in a plain text file and still keep it unpublished? A virtual file system looked like the right solution. A file system that can be read only by POV-Ray™ and only during rendering. A custom POV-Ray™ version wouldn't be a good solution. It is open source software, so it is possible to extend it with any functionality, but according to POV-Ray's license, even the custom versions have to be open source. That virtually means that LDD data will be accessible to anybody. And we wanted to keep the agreement with the LDD team. The second possibility was a true, operating system wide, virtual file system. Having done some internet research I quickly recognized that writing a file system driver for current versions of Windows was practically impossible for an individual person in some reasonable time. There were a few open source projects, but none of them was stable enough. Luckily, I found a professional solution from the EldoS Corporation. They offered a free license for non-profit projects, too. I did not expect to get one for such a small project, but I at least asked. Mr. Mayevski from the EldoS replied almost immediately and delighted me with his positive attitude. He was very nice and helpful, answered all my technical questions and gave me some useful advice for the implementation.
After that we knew, that we had everything we would need to publish the application. I made the first installation package and shared it with Johan. That was in February 2012. We started testing and experiments with materials and lights. Johan invested a lot of time in tuning the colors and classification of bricks according to different material finishes. LDD natively supports only shiny plastic and steel brick finish, but real bricks have many more different finishes.

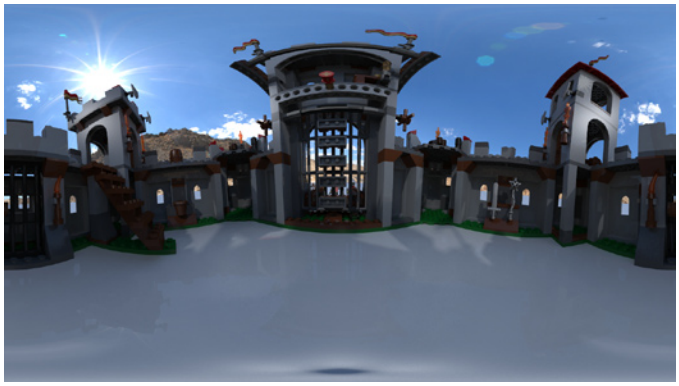


I then created a website for the project and started to write some basic help pages and reference information. After publishing the tool and making some fixes based on the experience of the forum members the announcement on the EB front page was made. With the exposure to a wider audience, the number of downloads really took off.
LDD to POV-Ray™ Converter was designed with ease of use in mind. Installation is a fully automatic standard windows installer, which will install both the application and virtual file system driver. It is not possible to use it as a portable application. POV-Ray™ has to be downloaded and installed separately as it is not included in the converter installation package. Only official builds of POV-Ray™ 3.7 are supported. Version 3.7 is the first version which supports parallel processing and on multicore systems it can utilize full CPU power.
For a beginner, to do the first rendering requires only opening LDD model in the converter and then clicking the “Convert”button. The model is automatically converted with the default settings, which are working quite well for most typical models. After the conversion POV-Ray™ can be started automatically and rendering starts immediately.
For an advanced user all settings which affect the quality of the output can be adjusted by changing the settings in the converter user interface. Conversion parameters are divided into 10 tabs.

Model
The first tab is named Model and settings on this tab control how the model will be converted,what level of detail should be used during the rendering and what other features affecting the model geometry should be active.

Scene
On the Scene tab you can control the appearance of the POV-Ray™ scene containing the converted model,what background color should be used or whether you want the base plane to be placed bellow the model. The position of this plane is determined automatically based on dimensions of the model in the POV-Ray™.

Camera
The third tab controls the behavior of the camera. The converter supports two most useful types of the camera - perspective and spherical. The perspective camera is the most common camera we all know from real life. You can adjust view angle, which has also influence on the perspective of the camera. Focal blur can be activated and it will improve the rendered image by additional realism, yet it slows down the render significantly. The spherical camera is not so well known and not used very often. With this camera the output image will contain 360° view of the model. The best example of such a render is a castle yard. Imagine yourselves standing in the center of a castle yard and looking all-round you. What you can see, will be on the image. These images are useful for HDR lighting. You can render your castle yard and use it later as an image for a sky sphere – to make your other models look like standing in the center of a castle yard – all reflections and incoming lights will look like that.



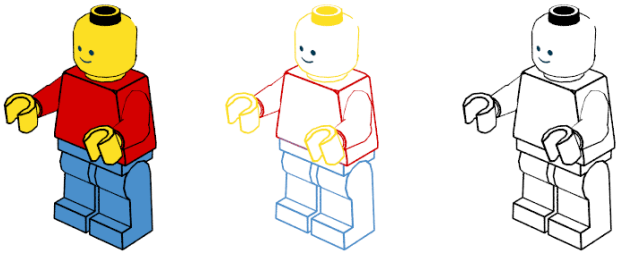
Lights
The Lights tab controls the color and number of lights used in the scene. Usually, the more lights you use, the better your output is, since in real life the light is also coming from many directions. However, each additional light source slows down the rendering process. Moreover, many users try to reproduce some studio lighting box conditions which usually means only two or three light sources. So the converter uses by default three light sources. On this tab you can specify also appearance of shadows in the scene. They can be completely disabled or adjusted from very hard, suitable for a space scene rendering, to very soft, suitable for some lighting box conditions.

Radiosity
The fifth tab is named Radiosity, which is not a very common term. In POV-Ray™ this feature enables simulation of an ambient lighting present everywhere. In combination with a sky sphere and a good HDR image for lighting, radiosity can be used instead of traditional light sources and final rendered model will have very natural illumination. For some HDR images emissive properties of the sky sphere have to be adjusted, otherwise the output colors may be tinted according to a dominant color of the used image.

Colors
On the Colors tab you can select color palette to be used during rendering process. The original LDD palette was optimized by the LDD team for use by LDD, but it is not very suitable for rendering. Black color is not black enough and also gray colors look strange. You can create your own palette or use custom palette supplied with the converter. Furthermore, there is also one special feature – color variance. Real bricks are produced in batches and different batches may have slightly different colors. Color variance randomly slightly modifies colors of used types of bricks and this way simulates the batches.

Materials
Each brick is made of a particular material (usually a shiny or dull plastic) and for each material it is necessary to define certain characteristics for POV-Ray™. Converter contains definitions of all materials and these standard definitions are used by default during rendering. It is possible to use custom material definitions by selecting appropriate materials or finishes file on the Materials tab.

Decorations
Converter allows specifying custom decoration images instead of the original decorations from the LDD. This feature can be activated on the Decorations tab. Decorations used in the model will be read by the converter and you can specify a new decoration file name for each used decoration. The new image replaces the original decoration completely for a given model, which means, all occurrences of that decoration on all bricks of the converted model will be replaced.



Outlines
For a building guide generating purposes model can be outlined just like in original building guides. On the Outlining tab you can select the level of detail and also colors of the outlines. It is possible to generate images in a “coloring pages” style. It is strange to use renderer to generate such images, but POV-Ray™ is currently the only alternative image generator from LDD models and some kids like to color the images of LEGO® models.

Rendering
The last tab – Rendering – is related only to resolution and quality of the output image. You can specify the desired output image size, anti-aliasing parameters and rendering quality without manually modifying POV-Ray™ ini files. To let the converter create ini file is the fastest way to define the most common rendering parameters and start rendering immediately after the conversion.
For an experienced POV-Ray™ user output settings can be controlled also by specifying custom include files with definitions of colors, finishes, materials and other scene elements. You can create these files based on files included with the converter. It is not recommended to directly modify supplied files, since they will be overwritten during application or LDD brick set update. The modified files should be saved under different names and you can use them during conversion as custom files for colors, finishes, materials and lights.

Next steps
Future enhancements of the LDD to POV-Ray™ Converter should cover mainly the quality of the brick geometry. Circle smoothing and improving rendering speed seem to be the most interesting features to be added. Materials and lights can be also improved. Since definitions of the materials are in included files and are directly editable, user experiments are possible and anybody can try to improve the definitions of the lights, colors or materials. Of course, feel free to request any other changes and features – just send your request through the converter website contact form.
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