

User Guide

This is a step-by-step guide on how to convert 3D models, that either you have made yourself or downloaded, into a format that is compatible with both Gazebo classic and Gazebo Ignition. It shows my pipeline of how I got my 3D models into a format which can be used in Gazebo. This guide is applicable to those that 3D model in Autodesk Maya or Blender.

Step 1: Modelling.

All of my assets were modelled in Autodesk Maya.
Make sure the topology is kept as simple as possible to help provide the quickest run time.
If you would like to learn more about 3D modelling in Maya.
Here is the link to Autodesk Maya's learning channel.
https://www.youtube.com/@Autodesk_Maya



Step 2: UV Mapping Asset.

I used Maya for this. When UV mapping your object, ensure all shells fit into a single UV tile.
If your model is too big to fit all UV shells into one tile, models can be split into multiple sections that can occupy their own UV tile, provided that each section is exported as a separate object.



Step 3: Exporting Asset.

All my assets were exported as an OBJ file as it is the most compatible with other software.



Step 4: Texturing.

All my assets were textured in Substance 3D Painter.
If you would like to learn more about texturing in Adobe Substance 3D Painter, here is a link to their YouTube channel.
<https://www.youtube.com/@Substance3D>



Step 5: Importing asset into Blender.

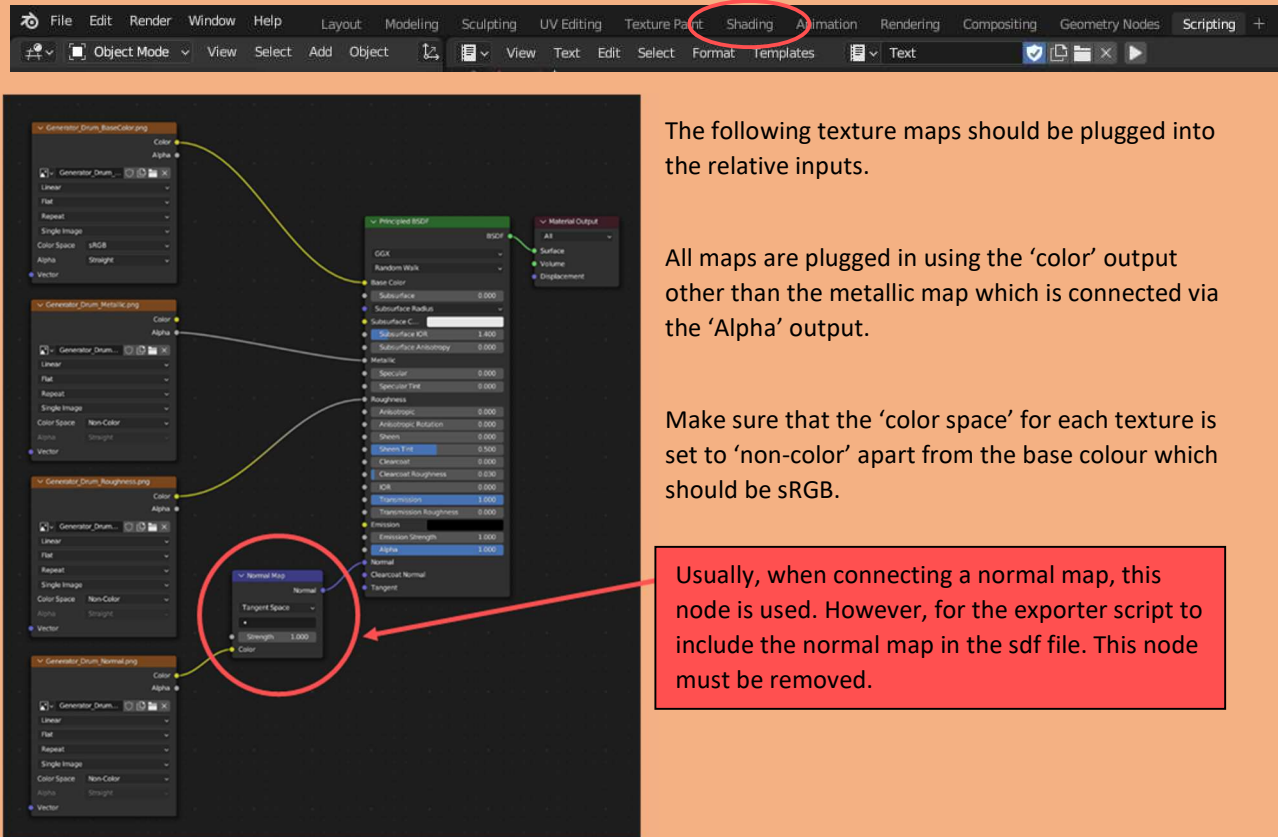
Import Mesh into Blender



Step 6: Attaching textures in Blender.

This can be done by dragging and dropping the PNG files from File Explorer, straight into the node graph under the 'shading' tab in Blender. This should drop an image texture node that can be plugged into the Principled BSDF node.

Alternatively, right-clicking, pressing 'Add' and searching 'image texture' will drop the same node. Then just press 'Open' and direct it to your PNG file from there.



Step 7: Import the exporter script and run.

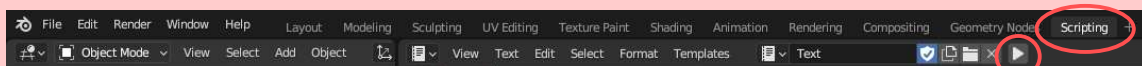
My script is made to export meshes and textures from Blender in a format that can be used in Gazebo. Import it by copying and pasting the script into the 'scripting' tab in Blender.

Running the script will create a folder for each mesh imported into Blender. Each folder will contain a COLLADA (.dae) file, a copy of each texture used, and a .material file which is used by Gazebo Classic. The script will also create an .sdf file and a .config file.

The script will loop so that multiple assets can be used in Blender, and it will create a folder for each mesh with its corresponding textures and .material file.

Run the script by clicking the play button at the top of the screen.

Please note that the script will only run if the blender file is saved somewhere on your machine.



Useful notes:

- Upon running the script, you will be asked to select a location to save your export files. It is recommended to create a new folder to export into.
- Folders will be named after the object name in the Blender outliner so make sure objects have a recognisable name.
- The model as a whole will be named after the Blender file name so make sure this also has a recognisable name.

```

1808 </link>
1809 </link>
1810 <link name="Roof">
1811 <visual name="Roof">
1812 <pose>0 0 0 0 0 0</pose>
1813 <cast_shadows>true</cast_shadows>
1814 <geometry>
1815 <mesh>
1816 <uri>model://Room/Roof/Roof.dae</uri>
1817 <scale>0.01 0.01 0.01</scale>
1818 <submesh>
1819 <name>Roof</name>
1820 </submesh>
1821 </mesh>
1822 </geometry>
1823 <material>
1824 <diffuse>1.0 1.0 1.0</diffuse>
1825 <specular>0.0 0.0 0.0 1.0</specular>
1826 <pbr>
1827 <metal>
1828 <albedo_map>model://Room/Roof/Roof_BaseColor.png</albedo_map>
1829 <roughness_map>model://Room/Roof/Roof_Roughness.png</roughness_map>
1830 <metalness_map>model://Room/Roof/Roof_Metallic.png</metalness_map>
1831 <normal_map>model://Room/Roof/Roof_Normal.png</normal_map>
1832 </metal>
1833 </pbr>
1834 <script>
1835 <uri>model://Room/Roof</uri>
1836 <name>Roof/Diffuse</name>
1837 </script>
1838 </material>
1839 </visual>
1840 <collision name="Roof">
1841 <geometry>
1842 <mesh>
1843 <uri>model://Room/Roof.dae</uri>
1844 <scale>0.01 0.01 0.01</scale>
1845 </mesh>
1846 </geometry>
1847 <surface>
1848 <contact>
1849 <collide_bitmask>0x01</collide_bitmask>
1850 </contact>
1851 </collision>
1852 </link>
1853 </model>
1854 </sdf>

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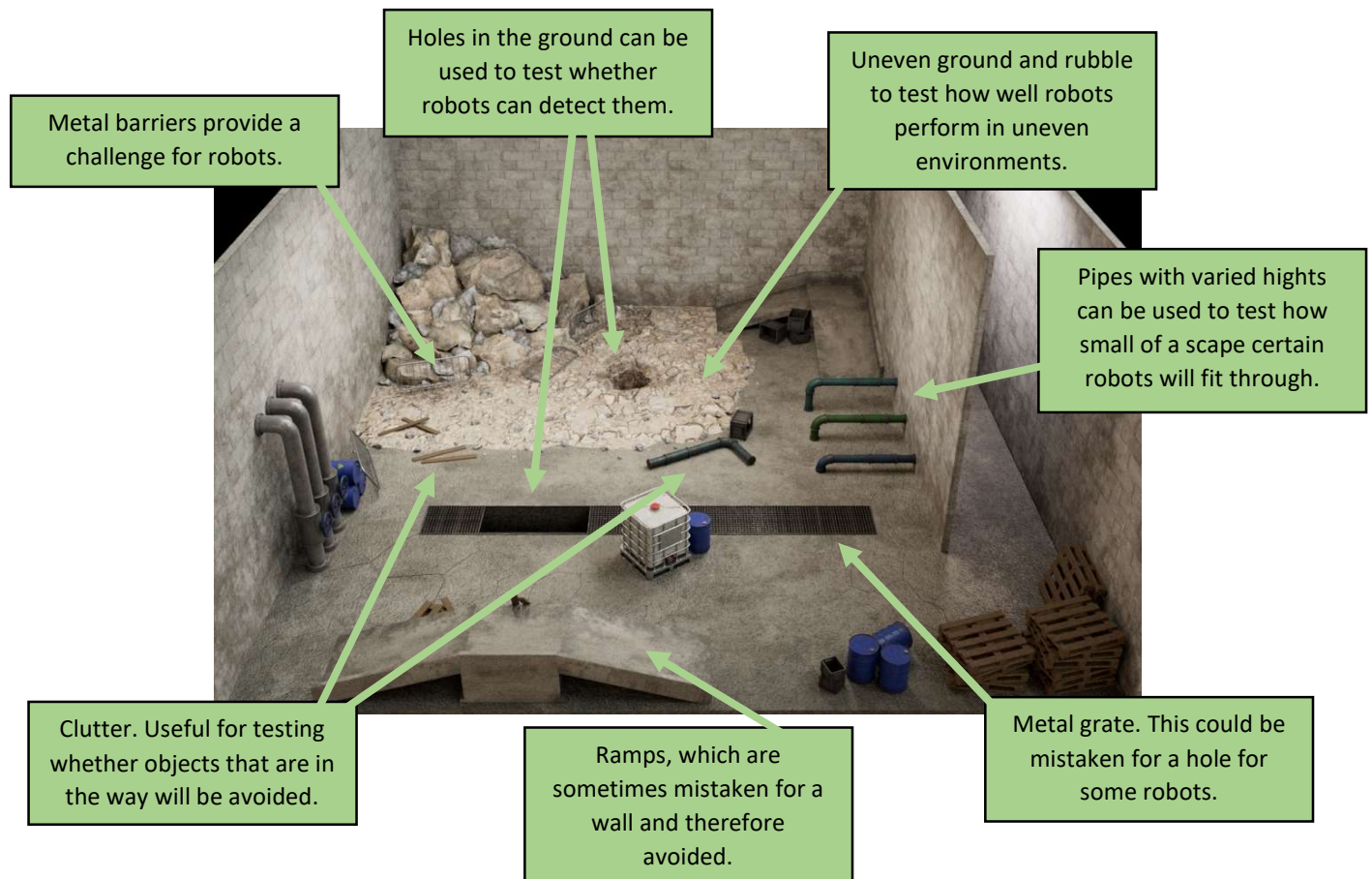
Using the environment without the roof:

If you would like to use the environment without the roof, this image shows the link to the roof geometry in the sdf script.

If you comment this section out. The environment will load without the roof mesh.

Robot Challenges:

I have created a small room as an extension of the environment, its purpose is to create challenges for robots. The image below highlights the features of this room and what obstacles it includes.



Below are some other areas of the environment



FAQs:

What are texture maps?

My assets come with 4 texture maps attached. These include:

- Base Colour – This holds all the colour data of an object
- Roughness – Controls how rough or shiny an object is, and where the rough or shiny areas are.
- Metalness – Controls how metallic an object looks.
- Normal – Adds bumpiness to an object e.g. cracks, concrete texture or wood grain.

The only texture map that is required for a very basic texture is the base colour map. The others will only enhance the overall texture.

Texture maps will usually be a PNG image file that is projected onto the model using it's UV shells.

If you would like to learn more about what 'UVs' are, here is a useful link:

<https://www.pluralsight.com/blog/film-games/understanding-uv-love-them-or-hate-them-theyre-essential-to-know>

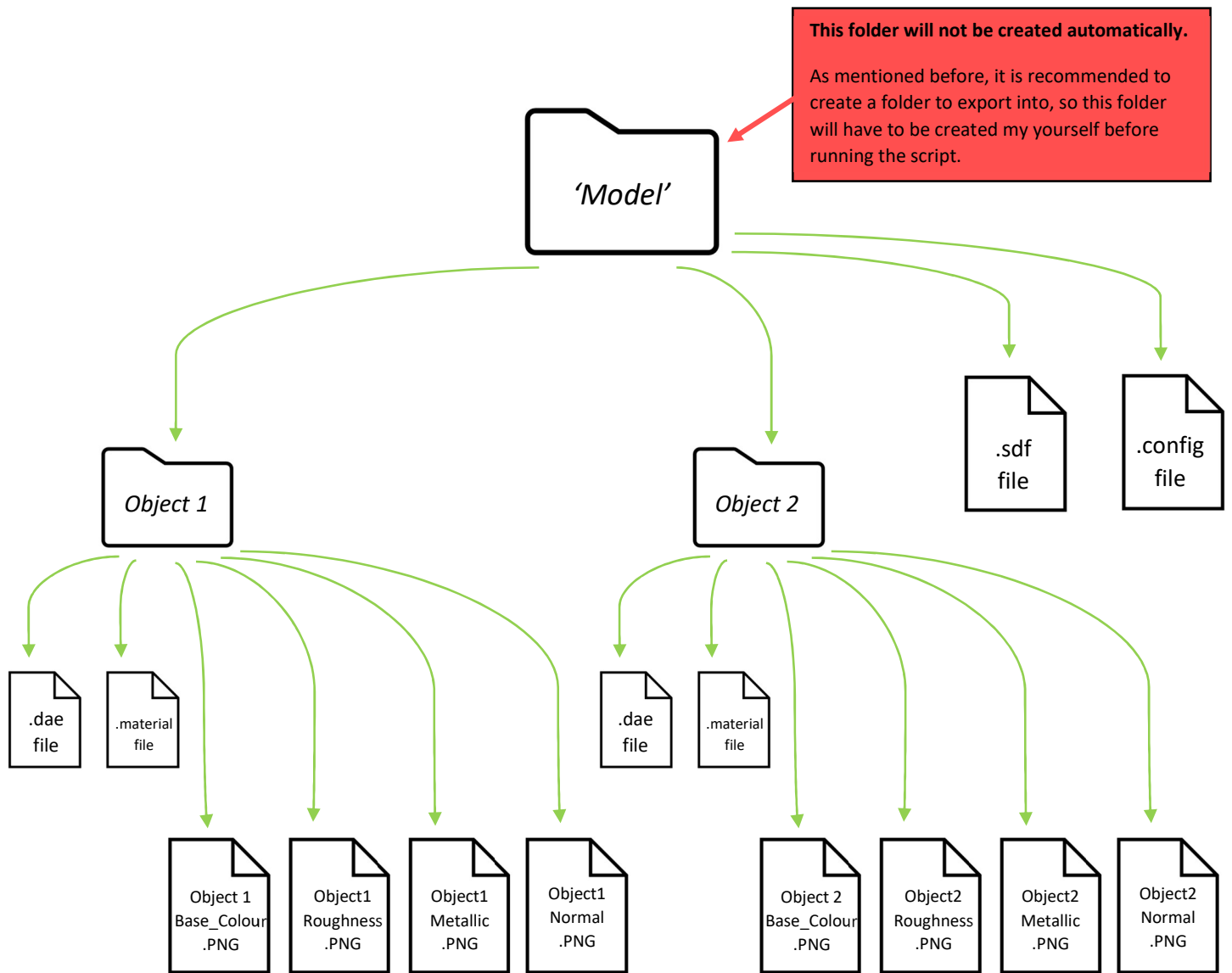
What file format should I use?

All my assets have been exported as OBJ files, which just hold the mesh alone, they do not store texture information. I have chosen to use OBJ files as they are the most compatible with other software.

My blender script outputs COLLADA files (.dae). This is a similar alternative to an OBJ file that is the most compatible to use in Gazebo.

Below is a representation of what the Blender exporter script will output:

(This will be an example of if your model was split into 2 objects. The exporter will create as many folders as there are objects.)



My File Structure.

For anyone who might like to carry on with this project in the future or edit any of my assets, here is an explanation of my file structure and where you can find everything you will need.

Name	Date modified	Type
Completed Assets	14/08/2023 14:12	File folder
Project0 (Whole Room)	14/08/2023 14:25	File folder
Project1 (Large Tank)	14/08/2023 14:04	File folder
Project2 (Pipe Walkway)	14/08/2023 14:09	File folder
Project3 (Generator)	14/08/2023 14:09	File folder
Project4 (Wall Tanks)	14/08/2023 14:10	File folder
Project5 (Turbine)	14/08/2023 14:11	File folder
Project6 (Pallet)	14/08/2023 14:11	File folder
Project7 (Barrel)	14/08/2023 14:11	File folder
Project8 (Water Tank)	14/08/2023 14:12	File folder
Project9 (Pallet Trolley)	14/08/2023 14:12	File folder
Project9.1 (Crate)	14/08/2023 14:12	File folder
Project9.2 (Fire Extinguisher)	14/08/2023 14:12	File folder
Project9.3 (Rocks)	14/08/2023 14:12	File folder
Project9.4 (Barrier)	14/08/2023 14:12	File folder
SDF_EXPORTER_BLENDER_CODE	14/08/2023 14:12	File folder

This image shows my Maya project files. I have created a separate project for each asset. Each is named accordingly.

You will find a 'Completed Assets' folder which contains the SDF folders for all assets. This will include all completed environments and small individual objects.

The image below shows the files that are inside each of the project folders shown above. These are the files that Maya generates automatically when creating a project, aside from a few that I created myself.

To use this project, most of these files can be ignored. The only ones that you will need are:

Name	Date modified	Type
assets	17/08/2023 09:53	File folder
autosave	14/07/2023 09:41	File folder
blenderFiles	16/08/2023 15:00	File folder
cache	14/07/2023 09:41	File folder
clips	14/07/2023 09:41	File folder
data	14/07/2023 09:41	File folder
images	09/08/2023 12:54	File folder
movies	14/07/2023 09:41	File folder
renderData	14/07/2023 09:41	File folder
sceneAssembly	14/07/2023 09:41	File folder
scenes	16/08/2023 16:04	File folder
scripts	14/07/2023 09:41	File folder
sound	14/07/2023 09:41	File folder
sourceimages	14/07/2023 09:41	File folder
substancePainter	09/08/2023 16:22	File folder
textures	09/08/2023 15:39	File folder
Time Editor	14/07/2023 09:41	File folder
workspace	14/07/2023 09:41	Maya Script File

- 'scenes' – This is where you will find all the Maya files.
- 'textures' – This is where you will find all the texture files.
- 'assets' – This is where you will find all the OBJ files for each project.
- 'images' – This is where you will find the HDRI files and some screenshots that I have taken.
- 'blenderFiles' – This is where you will find blender files and any files exported from blender. (Not every project will have this folder).
- 'substancePainter' – This is where you will find all the Substance Painter files where I have created the textures for each asset.

Media such as still renders and animations of the whole room can be found in the images folder under screenshots or animations. The individual render frames can be found in the renders folder.

Still renders of the individual assets can be found in their respective 'Screenshots' folders found in 'images'.

Reference Material

All reference material that I used for all projects can be found in a PureRef file, which can be found in the 'References' folder.



Section 1 includes real life images from different industrial environments.

Section 2 includes references for 500L Drums which were used in one of the 'Drum Store' environments.

Section 3 includes images of small objects used as 'clutter' in the environment.

Section 4 includes images of 3D models of industrial assets; this helps to visualise a simplified version of the objects.

A link to download PureRef can be found here:

<https://www.pureref.com/download.php>