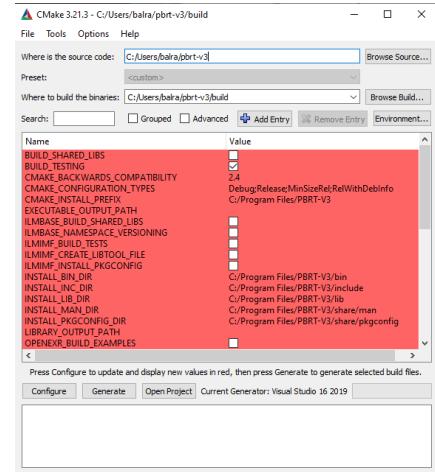


Computer Graphics: Reel or Real Coursework 1

Pbrt- Installation

Pbrt was installed by following the video instructions. Firstly the library is cloned from github and then cmake is used to make the build file. Then we open the file in visual studio to generate the executable file which is used to compile and render the exported pbrt files from blender. Pbrt exporter tool was also installed to export a blender scene to be rendered using pbrt-v3.



Pbrt- Test Image

To test the correct installation of pbrt and the scene exporter, a test image was generated. A simple scene was built using blender which consisted of the following:

- A monkey head with pbrt matte material and a mint colour
- A sphere with pbrt mirror material to show the backside of the head
- A plane to mimic a light source which can be seen in figure 1, a pbrt blackbody was used for this.

Once the scene was set up it was exported using the exporter tool and a pbrt file was generated. The pbrt file is then run using an executable file created in installation to render the scene resulting in figure 2.

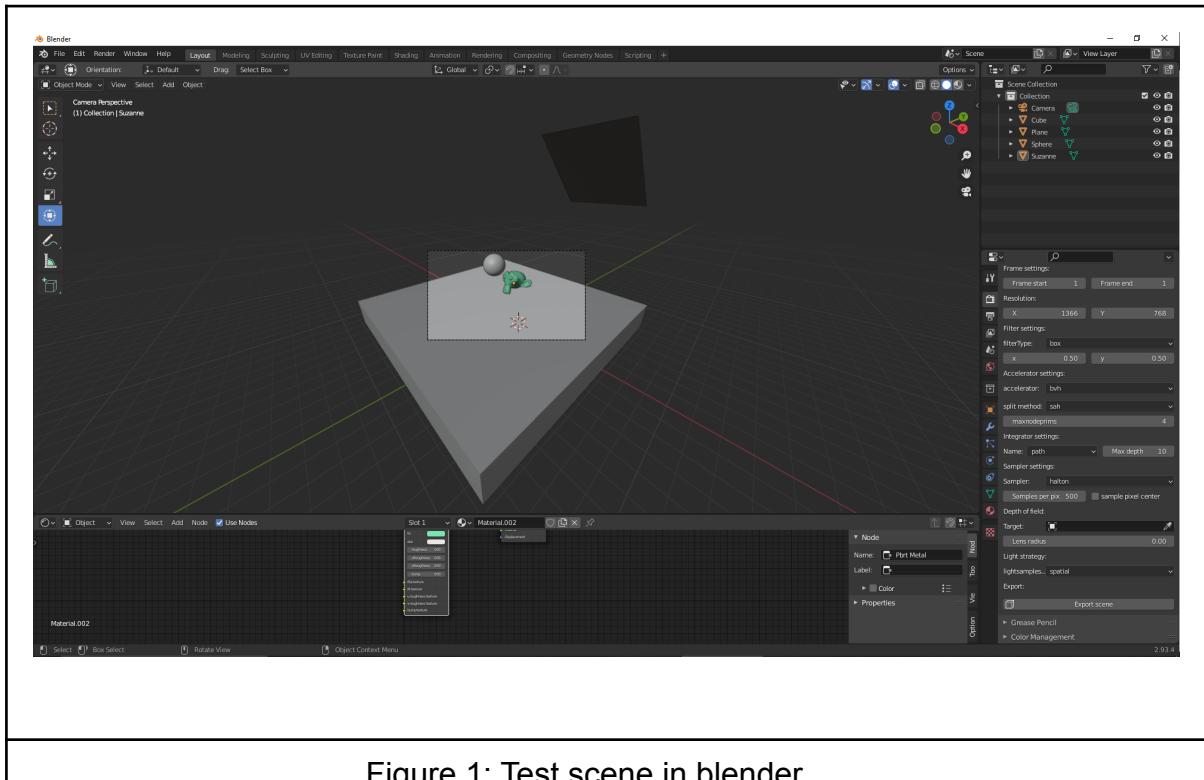


Figure 1: Test scene in blender

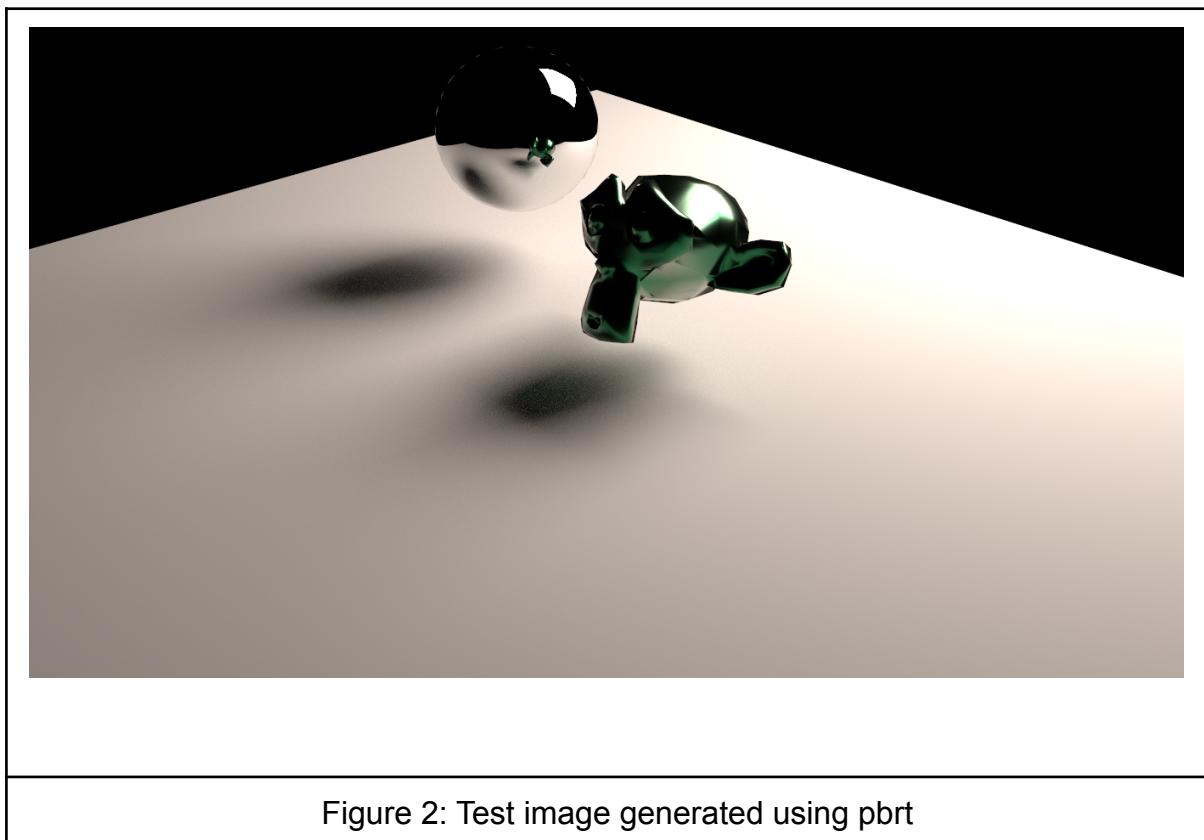


Figure 2: Test image generated using pbrt

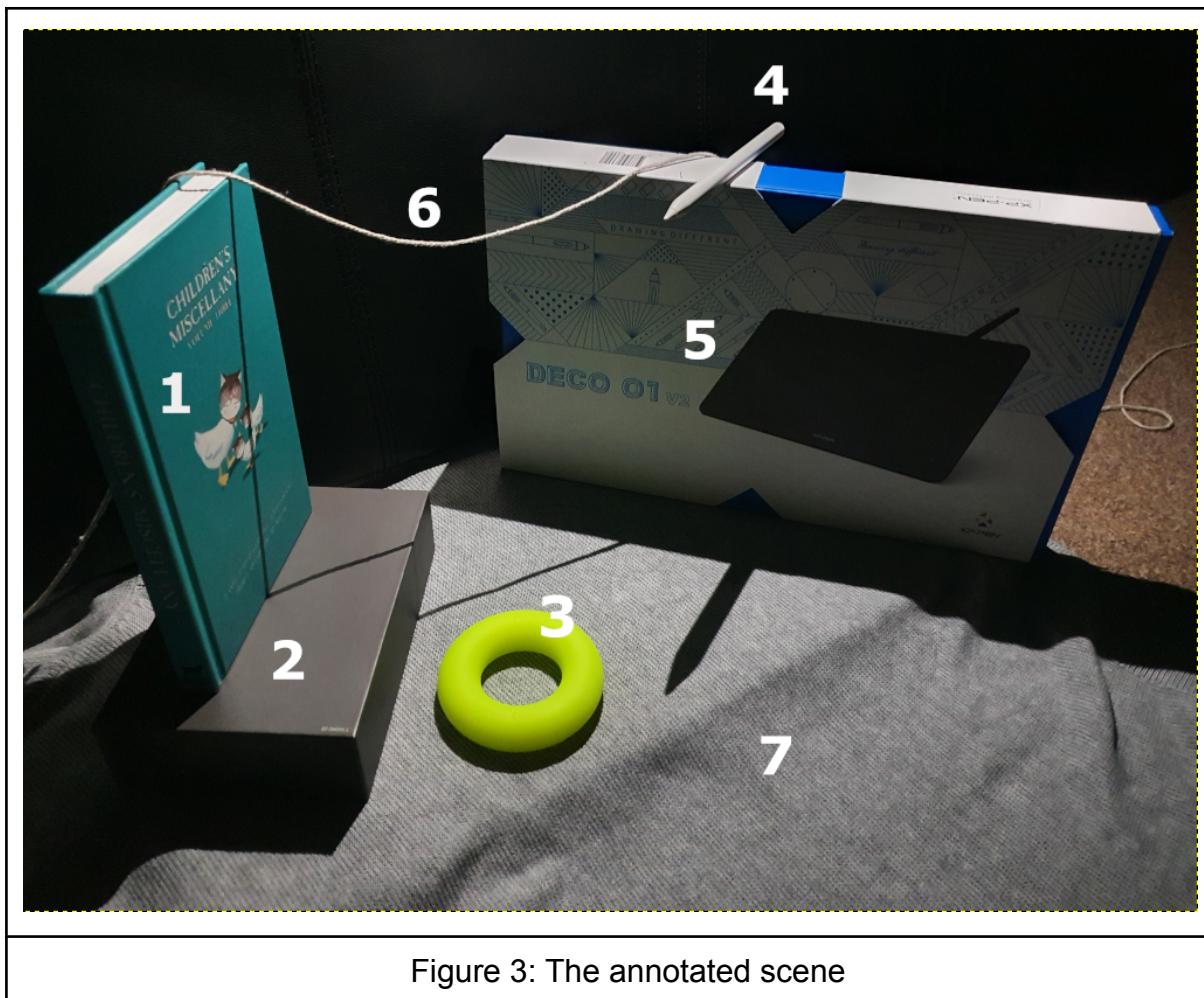
The scene

The scene (Figure 3) consists of the following:

- A mint green book on a grey box (1)
- A grey box under the green book (2)
- A Green rubber hoop (3)
- An apple pencil sitting on the white box (4)
- A white cardboard box under the apple pencil with a picture of a drawing tablet (5)
- A white string going over the scene touching the mint green book and the white box (6)
- All the items sit on a grey cloth (7)

Problems faced:

- Getting the light source position right to have enough shadow to interact with the rendered objects i.e the shadow of the string and pencil



Measurements of the Scene

Relative positions were measured using a ruler and a protractor. Approximate distances and angles were measured between different objects (Figure 4). The position of the light was approximately 40cm high and 14cm behind the blue part of the top side of the white box , from a phone flashlight.

Objects measurement

The mint green book: height = 20.5 cm width = 20.4 cm thickness = 1.6 cm

The white box: height = 22.5 cm length = 33 cm thickness = 4 cm

The grey box : height = 4.7 cm length = 18cm width = 11.9cm

The green ring: Outer Radius = 4.3cm Inner radius 1.1cm

Apple Pencil: Length = 16.6cm Radius = 0.45cm

Qualitative Assessment:

- Did not measure the position of the camera so small issues were raised when trying to position the camera in blender. Should have recorded the position to maximize accuracy of blender model to real scene.
- The angle of some shadows was not measured so had to approximate the angles from the picture itself resulting in some accuracy loss.
- The above points were fixed to an extent by simply adjusting the positions of objects in blender by looking at the real scene picture.

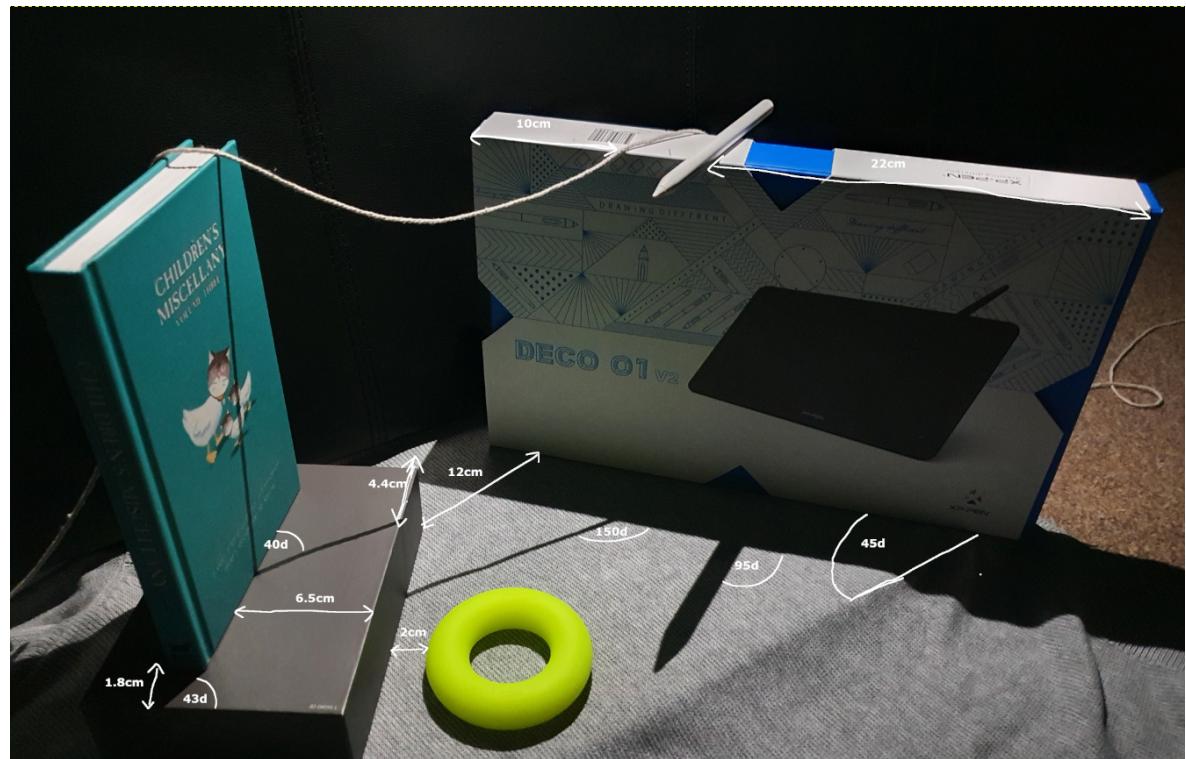


Figure 4: The scene with relative positions

Textures

To get the textures of the objects in the scene, their photo was taken and then cropped to get only the object's photos (Figure 5). For the objects only the front side photo needed to be taken as that is the only side that will interact with the rendered objects.

Qualitative Assessment:

- The photos could have been taken in better lighting to ensure the color is uniform at all locations on the image texture. For example in Figure 5b the bottom left corner is darker. Although the effects of this on rendered objects will be minimal to maximise the “realness” of the rendered objects, photos of textures should've been taken in better lighting.



Modelling the Scene

The scene was modelled using blender 3d modelling tool. The items from Figure 5 were modelled using cubes and a uv map was applied to them (Figure 6).

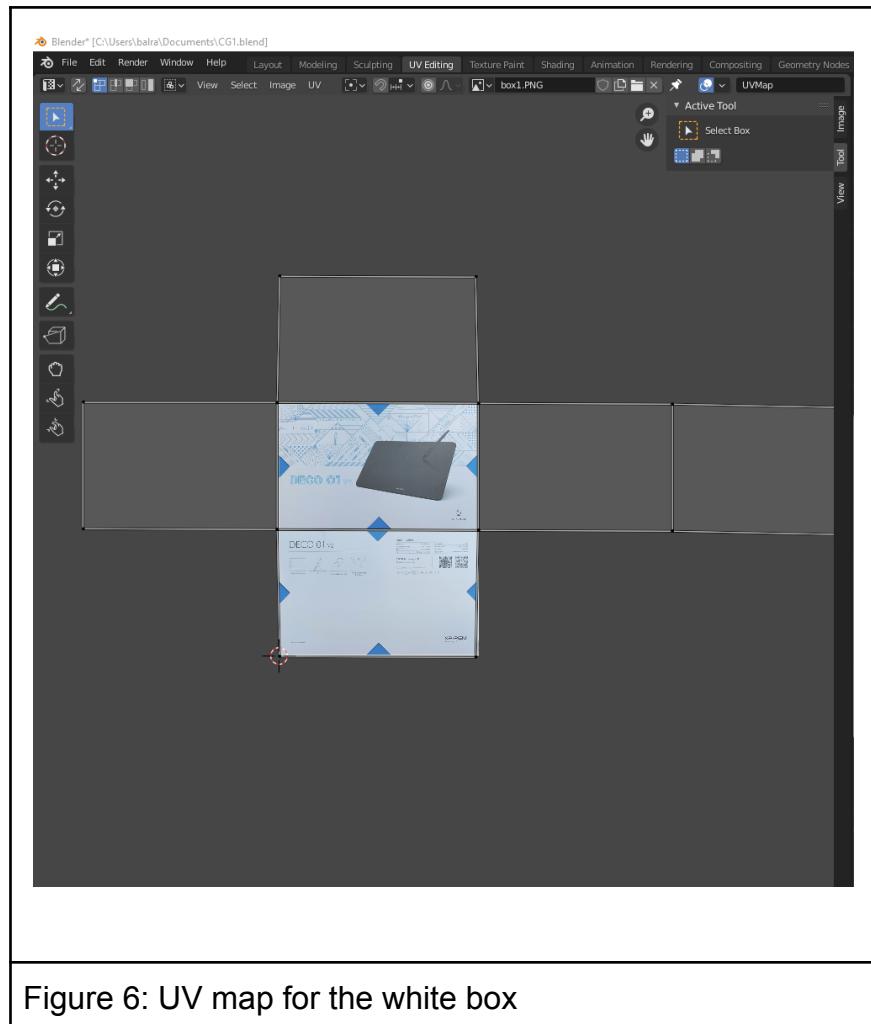


Figure 6: UV map for the white box



Figure 7: UV map for book

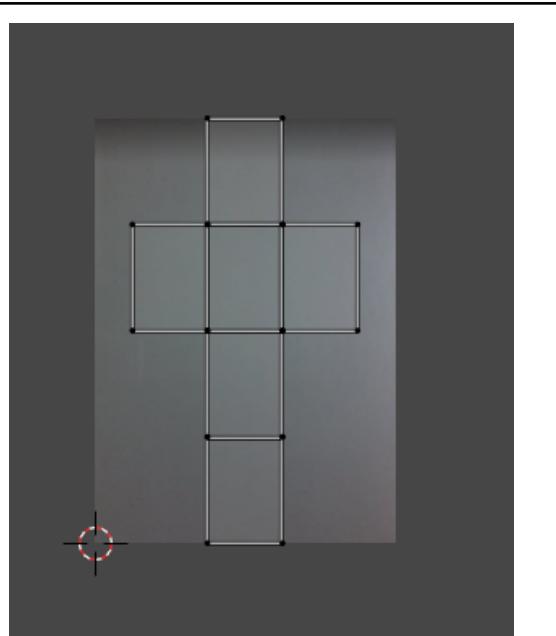


Figure 8: UV map for grey box

The following pbrt material and settings was used for the textures (Figure 9). The same was used for all 3 of the boxes.

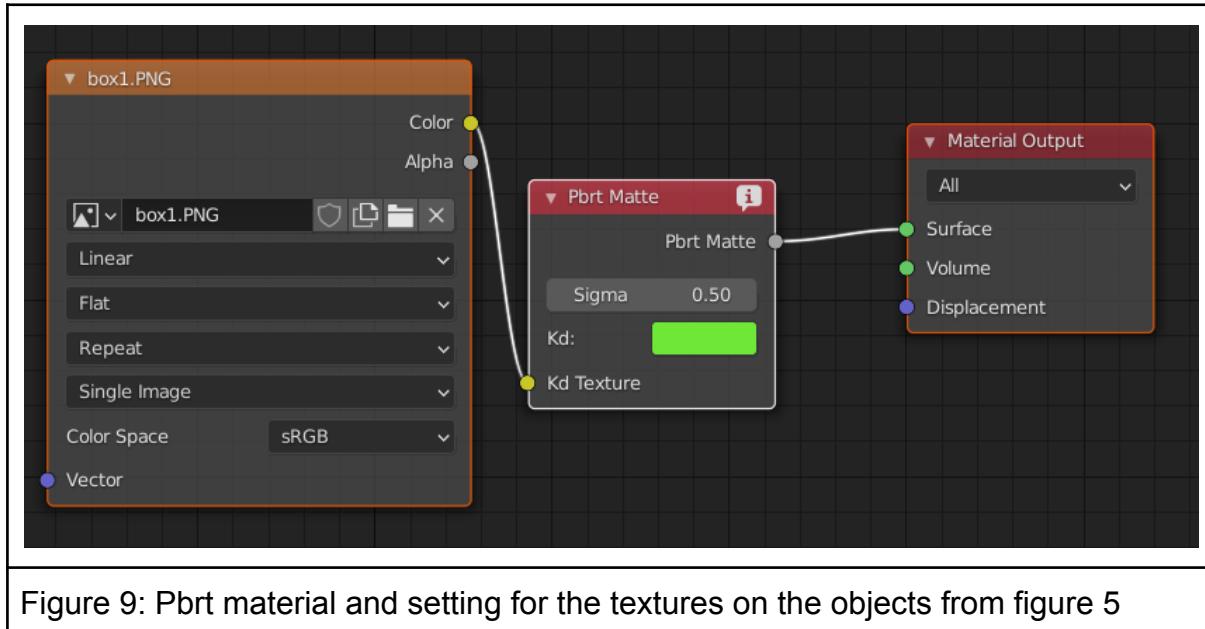
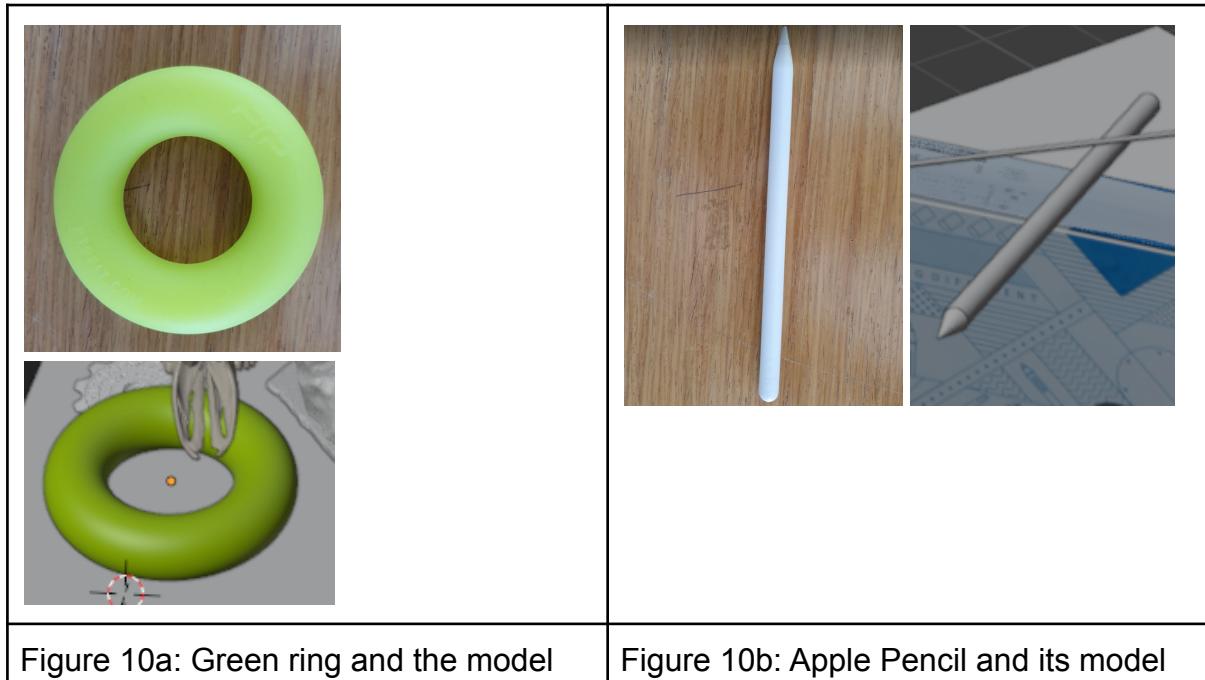


Figure 9: Pbrt material and setting for the textures on the objects from figure 5

The green ring (Figure 10a) was modelled using the torus object in blender using the pbrt material matte and the colour was picked from the picture itself. The apple pencil was modeled using a cylinder and a cone.



Rendered Objects

In total 5 rendered objects were used, 3 gears, a crocodile statue and a squirrel skull. The objects were picked from the Artec3D library. For the crocodile (Figure 11a) pbrt material metal was used with the default settings. For the skull (Figure 12), matte material was used and the colour for human bone was used to make it look like bone material. The brown gear (figure 11) on the edge used matte material. The other two gears use mirror material with the default settings.

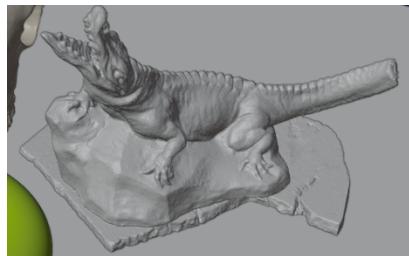


Figure 11a: Crocodile



Figure 11b: Gears

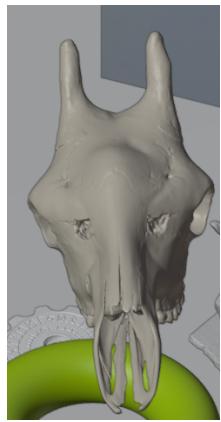
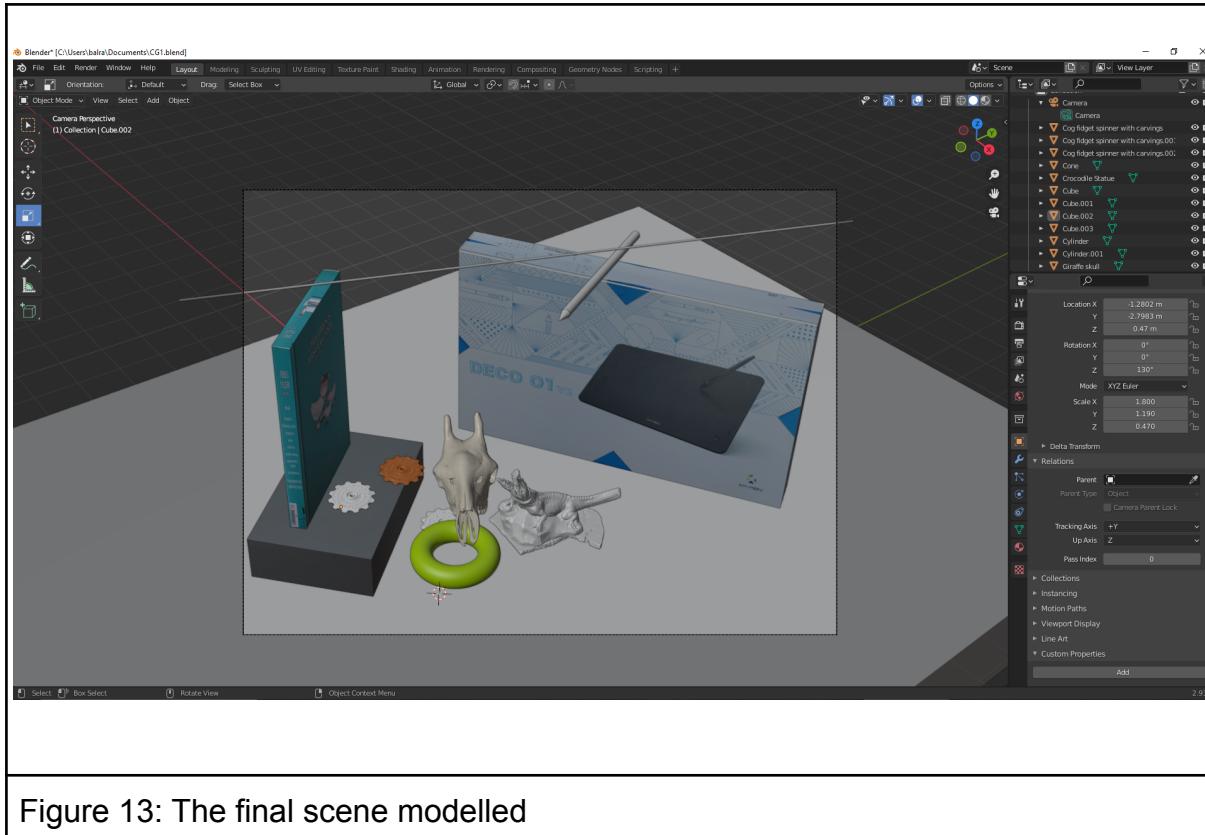


Figure 12: Squirrel Skull

The final scene modelled with all the objects from the scene and the rendered objects (Figure 13). The camera dimensions had to be changed to be the same as the scene photo dimensions (ratio of $1\frac{1}{3} : 1$). Since the blender light source cannot be used in pbrt it is deleted and a new light source is added. To simulate the phone light a uv sphere, in blender, is used with the pbrt material blackbody. Since we want sharp shadows the light source has to have a really small surface area. The settings used for the light are in figure



Rendering the Scene

Finally the scene is rendered using pbrt in command line (Figure 15). The samples per pixel was 300 and resolution was 2000px by 1500px. Interesting features are the following:

- The gear reflecting the book
- The shadow of the string going over brown gear and the skull
- Reflection of the skull in the gear under it
- Reflection of the Green ring on the crocodile statue
- Shadow of the skill on the green ring
- Shadow of the pencil on the crocodile statue
- The shadow of brown gear on the gray box and the floor

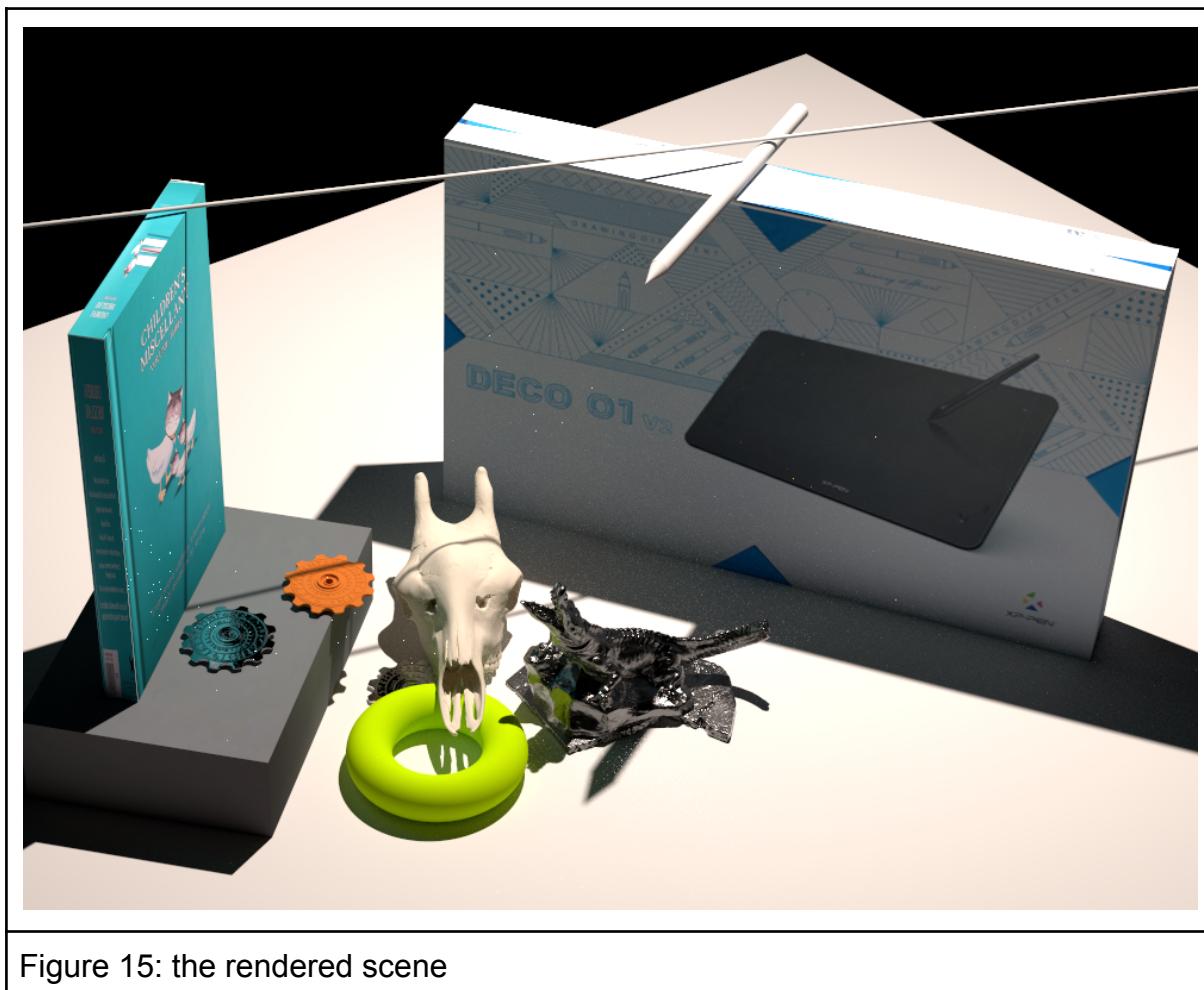


Figure 15: the rendered scene

Composition

Once the scene is rendered with the fake objects we open it up in GIMP. The fake objects were then cut out using the free select tool in GIMP

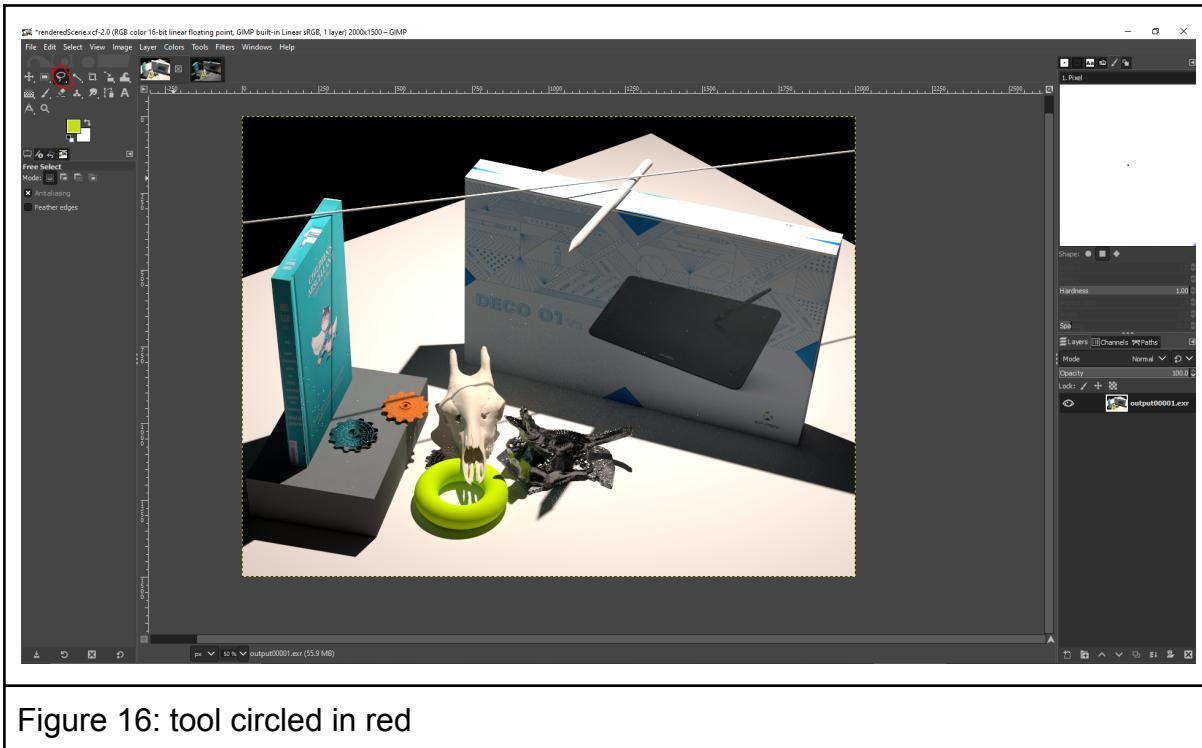
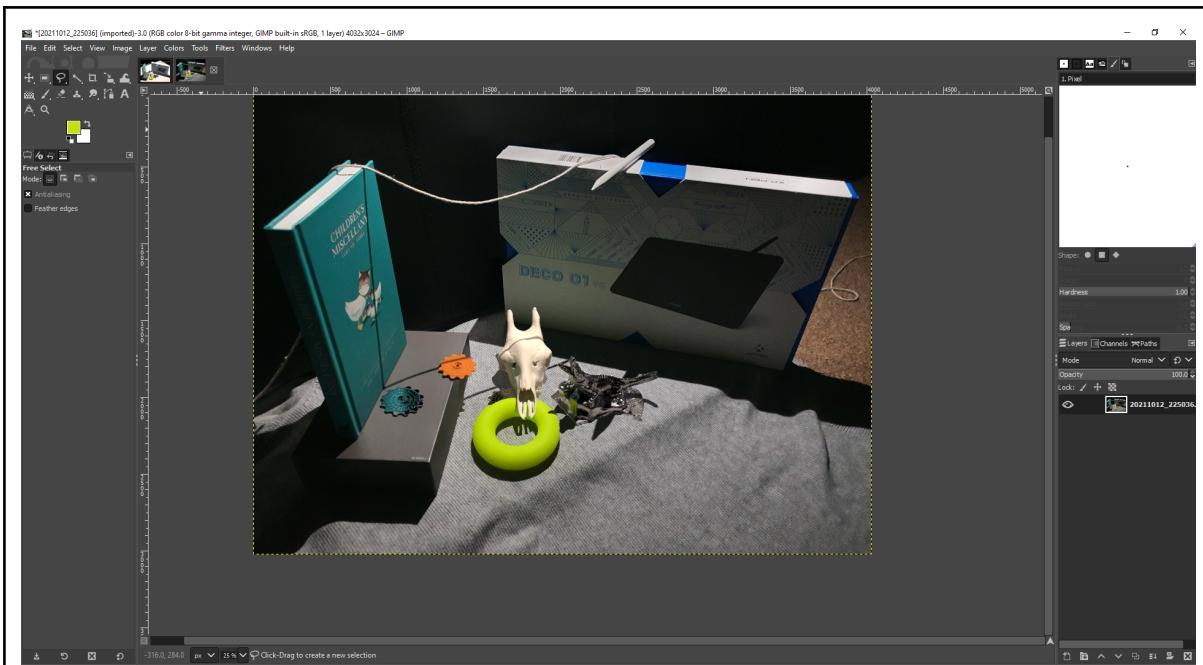
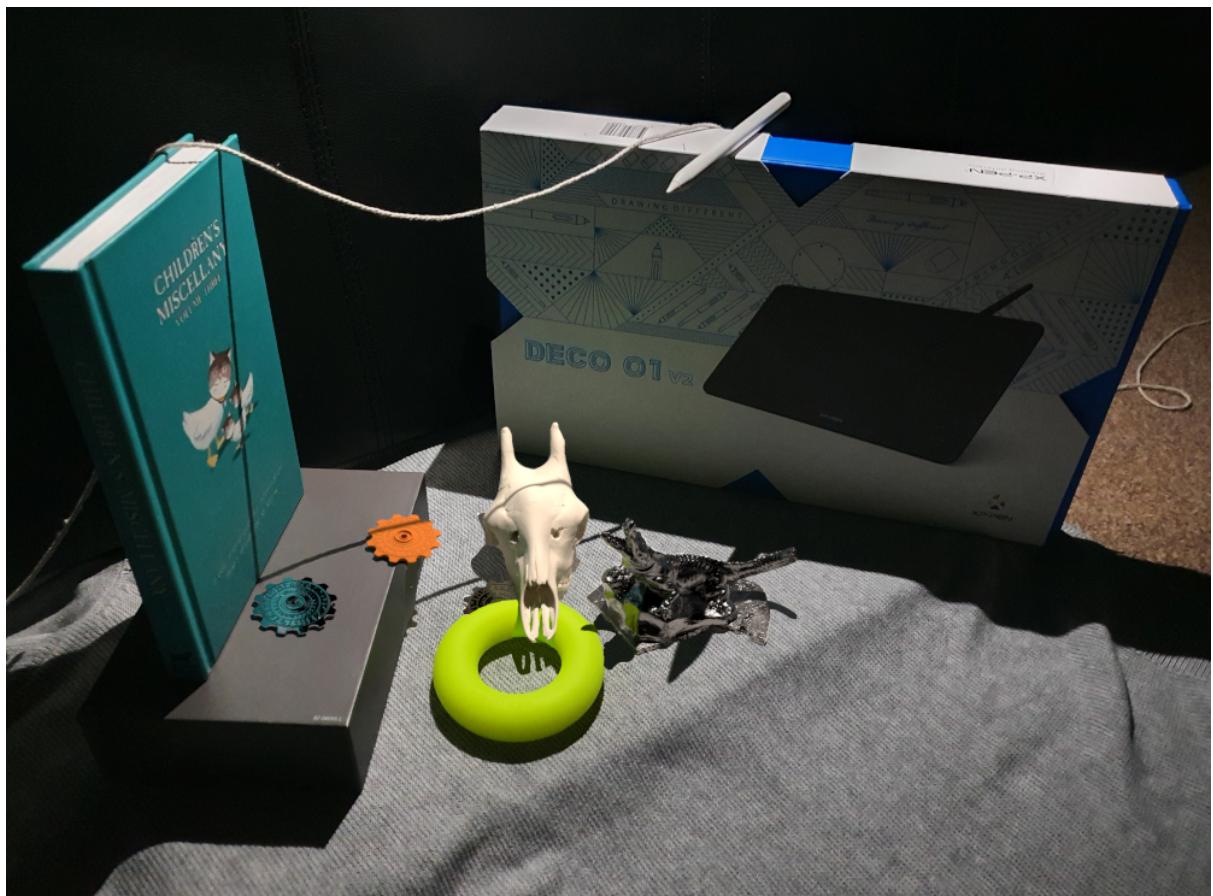


Figure 16: tool circled in red

Then the cutout were placed in the photo of the original scene by copy pasting them (Figure 17).



GIMP with the cutouts placed in real scene



Cutout from the surrounding materials was used to fill in the shadows. For example the shadow from under white box shadow was used to fill the shadow of the skull. Forgot to use the floor in blender model.

