The Incandescent Duet

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I got inspired to create this scene after a jamming session with two super talented violinists (I'm a hobby pianist). My focus throughout the project was on creating an atmosphere that simultaneously captures the calm and warm sound of a piano and the brilliant, shining, and enchanting sound of a violin. I therefore spent most of my time on lighting, color composition and on creating smooth reflective effects.

Scene Composition

The focus of the scene is a violin, sitting on top of a piano keyboard. Two candles placed on each side of the piano provide the main illumination. An open book with sheet music gives the scene its liveliness, suggesting that the instruments are about to be played. Three red roses behind the music stand balance the scene focus and create a more romantic atmosphere. A violet spotlight is highlighting the piano keyboard while playing the counterpart to a scene that's otherwise dominated by warm colors. It makes the violin's shadows appear violet instead of black. An additional warm area spotlight is illuminating the sheet music while creating intriguing shadows on the sheet music and music stand. An additional spherical area light is placed in front of the violin. This light creates a large smooth reflection on the violin and on the black piano keys, as well a bright spot on the back wall on the left side of the image. The back wall shows a smooth shadow of of the candle and the candle holder that comes from the second candle flame which is not in the field of view of the camera. Two bright spots of slightly different shades of yellow frame the candle's shadow on the wall.

Lighting

Most of the work has been spent on lighting. The main lights are the candle flames. The flames are simple, diffuse, non-transparent 3D shapes. The flames are the only objects in the scene that have an ambient term, to make them appear more realisitc. The white color gives the impression of saturation of the camera sensor. Around each flame, many point lights are placed random uniformly on a sphere, imitating a spherical area light. An actual spherical area light was also implemented, but this implementation needed a high sample rate to not create grainy shadows. This is why I finally decided to go with a lot of point lights to create smooth shadows. The ability to discriminate individual shadows from the point lights does not hurt the appearance of the scene as much as grainy sampling artifacts.

The second most important light of the scene is the point light creating the reflection on the body of the violin, the bright spot on the left side of the image, and the shadow of the violin's neck on the piano. I started out with a point light, but noticed that the shadow looks too sharp and unnatural. Instead of using an area light to fix this, I used the above mentioned "hacked" implementation of a spherical area light to make the shadow appear smoother.

Finally, the scene contains to spotlights. The violet spotlight balances the color of the scene while highlighting the piano keyboard. It brightens up dark regions and makes shadows appear in a nice violet light. There are no relevant shadows created by this light, so there was no need to worry about smoothing out edges.
This is different for the second spotlight. The second spotlight is directed towards the upper part of the violin and the sheet music. Its main effects are the intriguing shadows on the sheet music and the music board, as well as the reflection coming from the right side of the music board. Similar to the area lights from before, instead of one I used many spotlights that are distributed random uniformly on a disk with the normal being the direction of the spotlight) to create smoother shadows.

Modeling

I modeled the piano keyboard from scratch. I spent the most time on working out little design and geometry details, especially on the black keys which are highly reflective. The white keys are textured with a subtle ivory texture that makes them appear more realistic and less uniform. There is a physical gap between all white and black keys, creating a the impression that the piano keys would actually move if someone sat down to play it. The keys are damped by red felt placed between them and the wood of the piano body. The red felt shows in the bottom right corner.

The violin, the roses, the candles (without flame) and the piano body are downloaded from the web and have not been changed significantly apart from textures and materials. For the book pages I used a texture for old, yellowish book pages, and overlaid it with a black and white image of one of my favorite piano pieces (Liebestraum no. 3 by Franz Liszt).

Technical contributions

A lot of work was spent on photon mapping for global illumination. Using the assignment framework as a start, the correct color of the photons was added. Instead of a fixed radius search, the radius in which to include photons from the map is changed dynamically in order to get a certain number of photons from the photon map for each sample (similar to KNN search, using the provided FLANN implementation). The contribution of each photon is weighted depending on its distance to the intersection point. To reduce computation, the photon mapping is only performed for some samples.

This doesn't affect the rendering much because aliasing is not as much of a problem for the relatively faint light from global illumination. For the final render, photon mapping was too expensive, which is why it didn't make it into the final scene unfortunately. The images below show an early version of the scene rendered with photon mapping, and the contribution of global illumination separately (without any direct illumination). Note how the candles get a nice glow.


Indirect illumination (Photon Mapping) only.

Direct and Indirect Illumination.

A camera that enables a depth of field effect has also been implemented. The depth of field effect is created by a simple pinhole aperture with a finite pinhole radius rather than a complete lens model. The direction of the sampled rays is then changed so that they intersect at a specified focal plane. The depth of field effect didn't make a lot of sense for this camera position, so it's not used for the final render. It does, however, look very nice when the camera is placed directly above the piano keys, as shown in the quick (and therefore quite grainy) render below.

Depth of Field Effect in Variant A
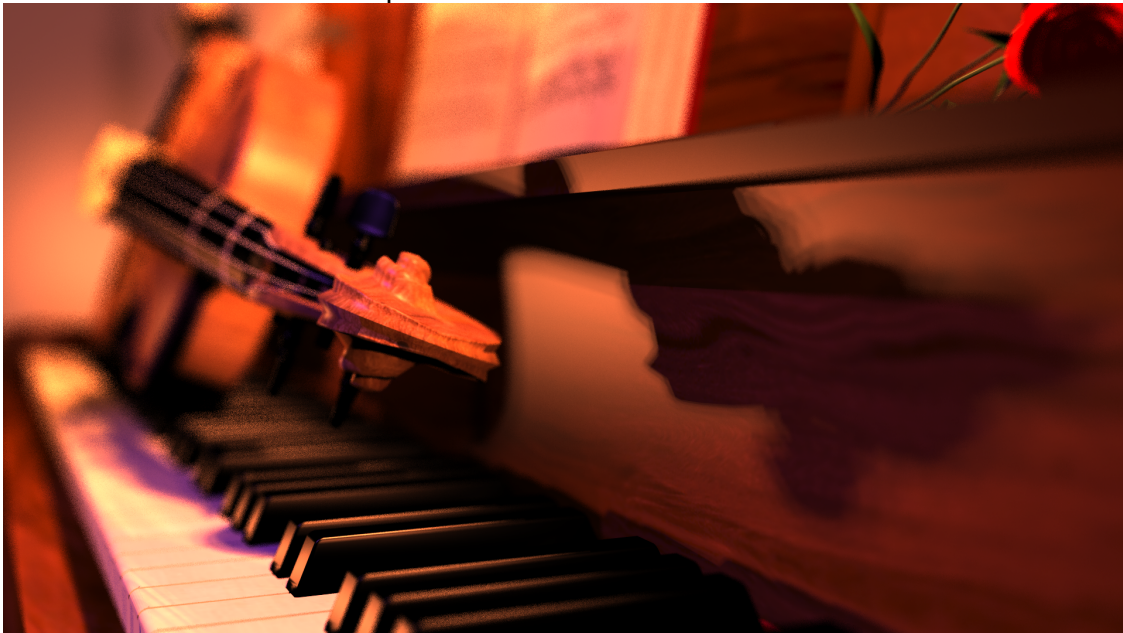
Variant A: A different perspective
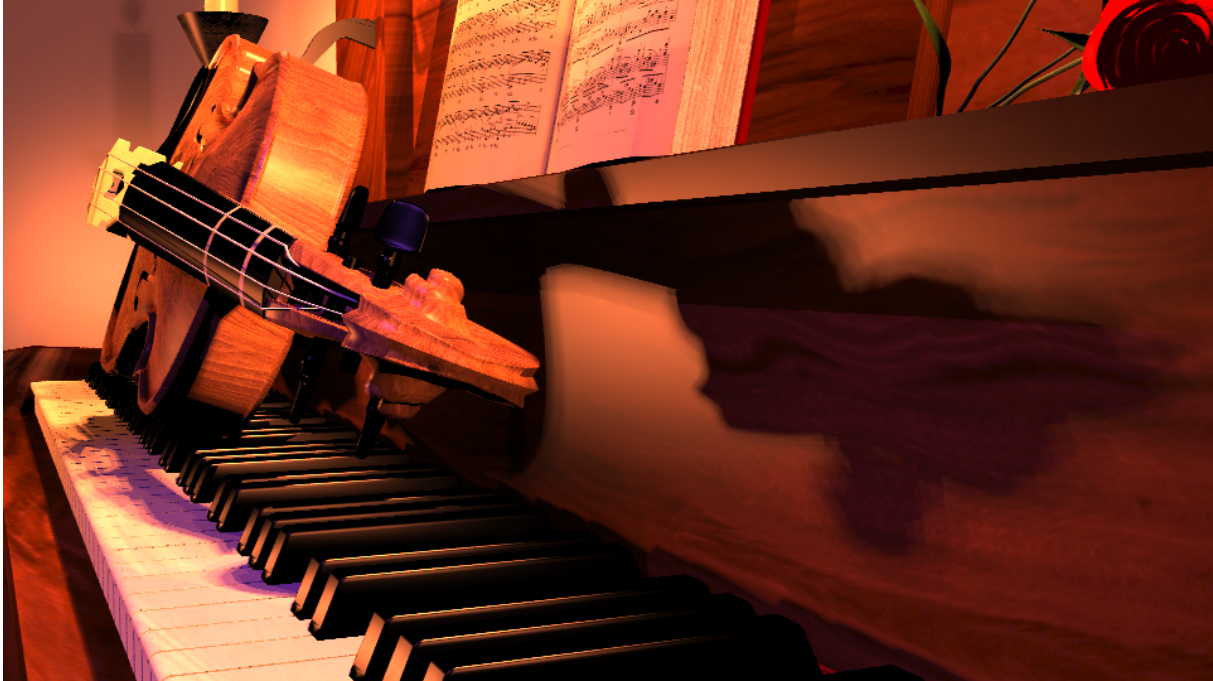
Variant B: A purely diffuse gray scene