Final Project

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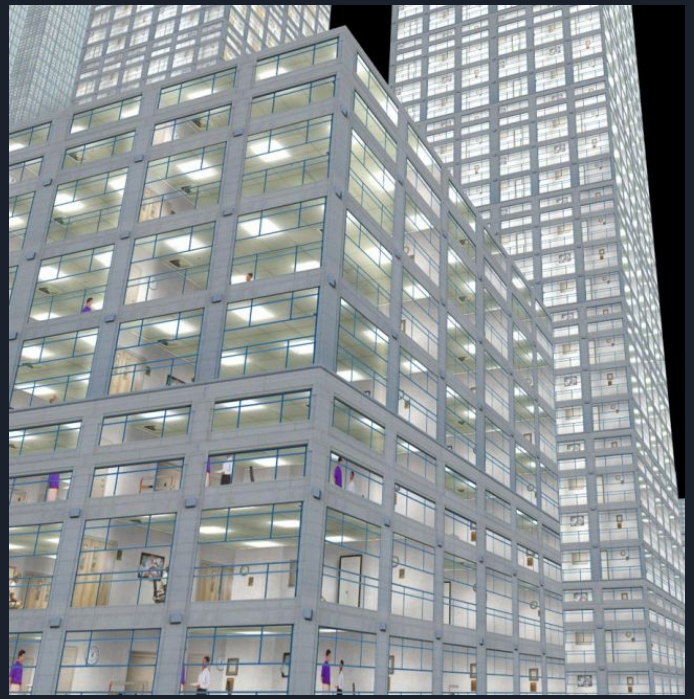
Interior Mapping

The technique was invented by Joost van Dongen in 2008.

“Interior Mapping is a new real-time shader technique that renders the interior of a building when looking at it from the outside, without the need to actually model or store this interior.” -Joost van Dongen

The mapping happens entirely on the GPU with no geometry required for the interiors of buildings.



How it works

Ceilings and Floors

- Consider that there are horizontal planes (xz-axis) at regular intervals throughout the building
- For each pixel on the building, we cast a ray from the camera to that pixel
- We can use the function: ceil(y / d) * d (y = y-pos of pixel, d = dist between planes) to find the y-position of the ceiling above the pixel
- The floor below the pixel can be found similarly with: (ceil(y / d) - 1) * d
- We know whether we are looking at the ceiling or the floor based on which plane gets intersected first.
- From here, we can use the intersection points' xz component as UV coordinates for a texture lookup.

How it works

Walls

- Walls can be approached in a very similar way to ceilings and floors.
- Now consider that there are planes on the xy-axis and yz-axis at regular intervals.
- The intersection point of these planes can be calculated in the same way as with ceilings.
- The plane whose intersection point with the raycast is closest to the camera should be used as the UV coordinates for its appropriate texture.
- This ensures that all walls, ceilings, and floors are viewed with the correct perspective

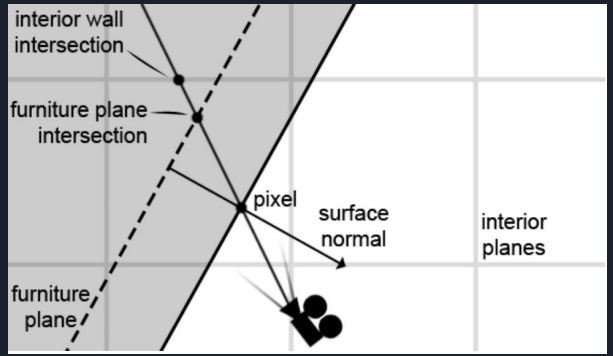
How it works

Putting it together

- The interiors of buildings (walls, ceilings, and floors) are being drawn correctly.
- The interiors can be mixed with building exteriors.
- A diffuse texture can be used to store window positions using it’s alpha value.
- Then, the interior texture and exterior texture get mixed using this alpha value.
- Lot’s of nuance can be added through window reflections. (similar to the cubemap lab from week 3)

Taking it further

- Even more detail can be added through the “furniture plane”
- The “furniture plane” is a plane parallel with the surface of the building that has been translated slightly into the building.
- If the closest intersection to the camera happens with the furniture plane then the pixel is looking somewhere in the center of the room.
- In this case, lot’s of textures can be rendered here to simulate items in the rooms.



Smoke Effect

Graphical smoke effects are used in different ways from simulations of airflow for vehicle design to smoking in video games like team fortress 2.

Since smoke is a gaseous fluid, to recreate its effects graphically it requires the use of Navier-Stokes equations.. These are equations that are used to model fluid dynamics because gases are affected by many different forces including air flow.

For smoke effects, instead of tracking every particle, a smoke density is used. It determines where smoke is based on a scale from 0 to 1, 0 being no smoke.

How it works

It works by diffusing its color to its neighboring cells and then dissipating its own color. Then each of its neighboring cells does the same.

Each of these pixels do this every frame.

This results in the colors from the origin of the smoke to billow outward simulating real smoke.

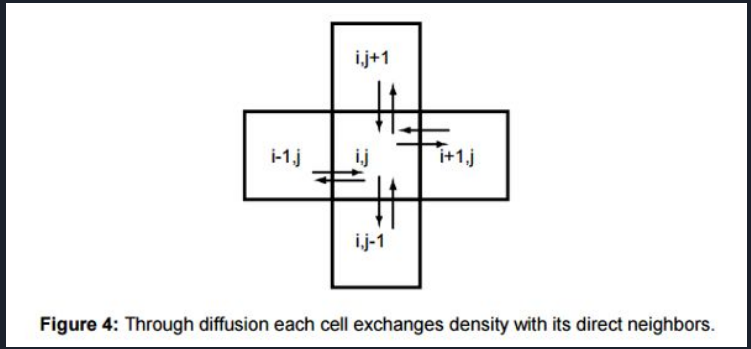
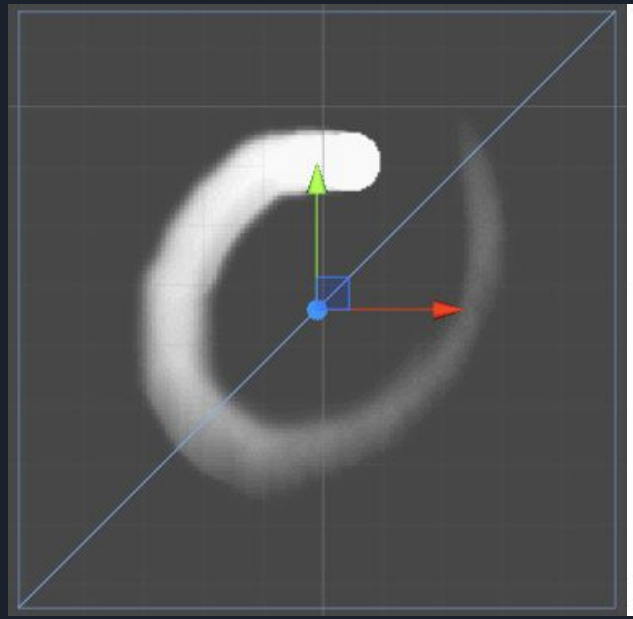
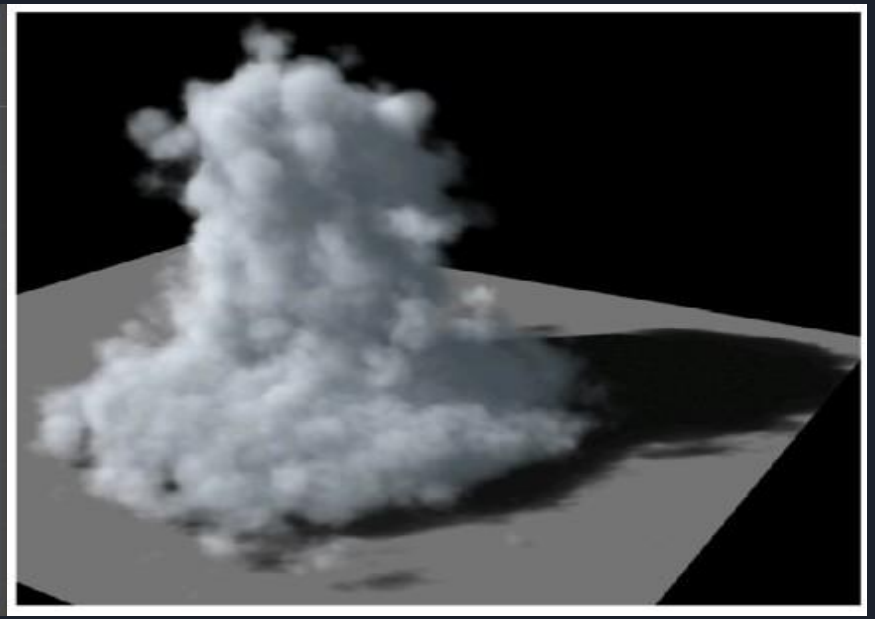


Figure 4: Through diffusion each cell exchanges density with its direct neighbors.

Example Pictures



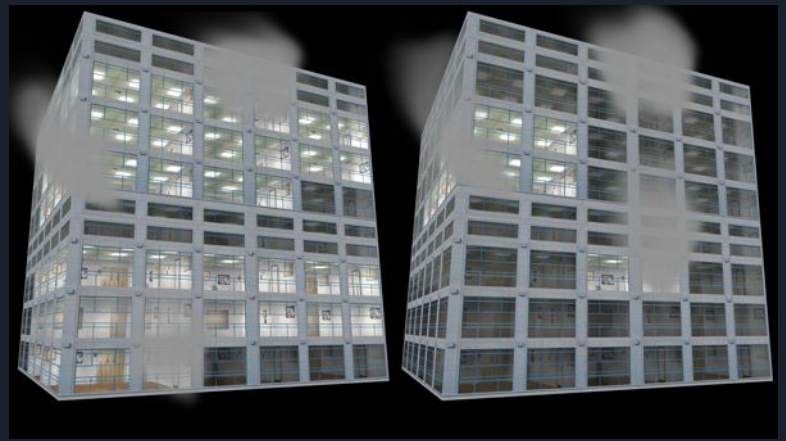


Plans on implementation

I plan on combining the use of smoke with the building used for interior mapping.

Some of the rooms will have smoke either in the rooms or coming out of the the windows

To make them appear in the rooms
I will map the smoke onto a texture and map it onto the furniture layer for the interior mapping.



Volumetric Clouds

- Full Screen shader that uses raymarching through a texture to render full 3D clouds on screen.
- I will add clouds to the scene of the buildings to give a realistic background.
- Lighting

Distance Fog

- A technique used to enhance the perception of distance by shading distant objects differently
- In early 3d games this was used to hide draw distance problems due to hardware limitations
- Some games such as Silent Hill used this as an atmospheric technique
- This will be implemented on some objects in the scene as they get farther away from the camera,

Examples of Distance Fog

References

Smoke:
-http://www.dgp.toronto.edu/people/stam/reality/Research/pdf/GDC03.pdf
-https://gamedevelopment.tutsplus.com/tutorials/how-to-write-a-smoke-shader--cms-25587
-https://en.wikipedia.org/wiki/Navier%E2%80%93Stokes_equations

Clouds:

-https://assetstore.unity.com/packages/vfx/shaders/volumetric-clouds-25527