Scuola universitaria professionale della Svizzera italiana
Dipartimento tecnologie innovative

SUPSI

Real-time volumetric cloudscape in OpenGL

Student
Axel Salaris

Advisor
Randolf Schärfig

Tutor
Achille Peternier

Industrial Partner

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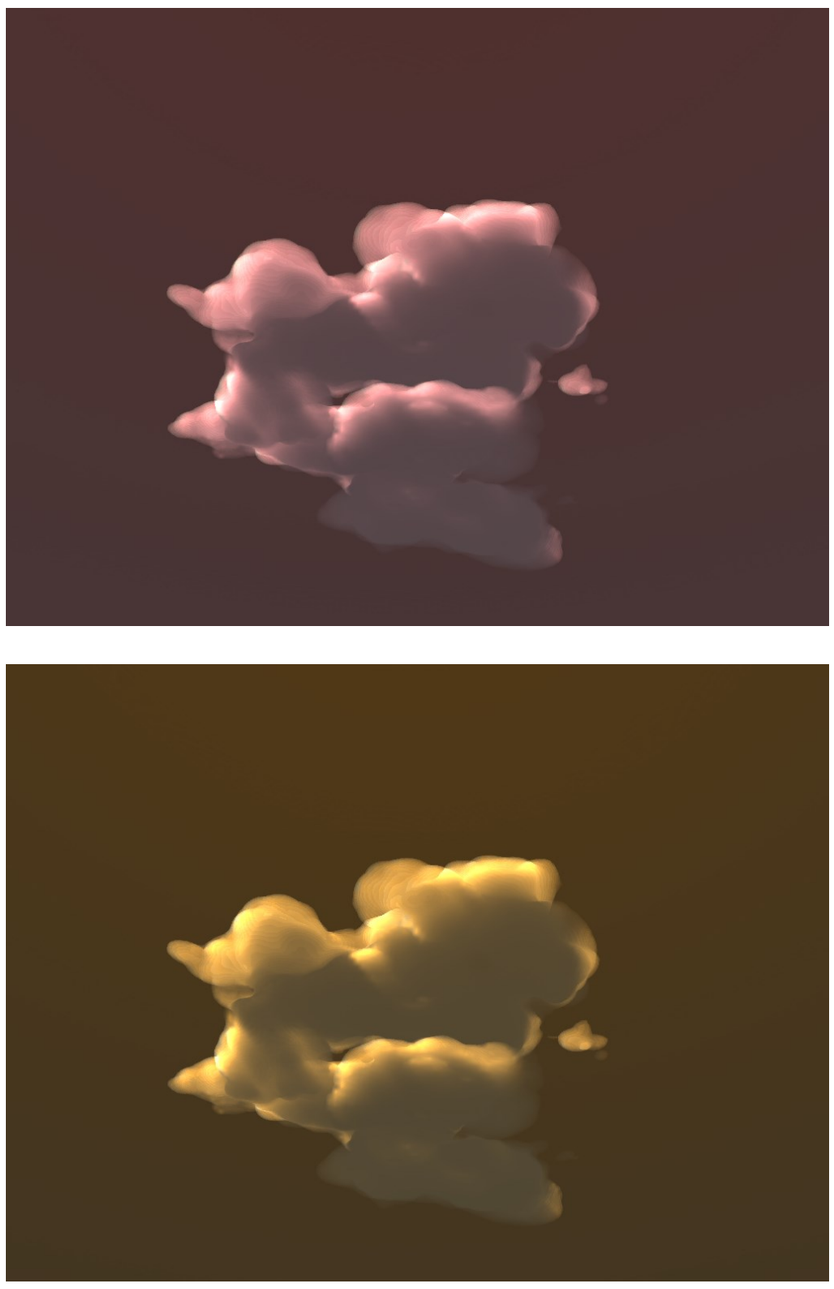

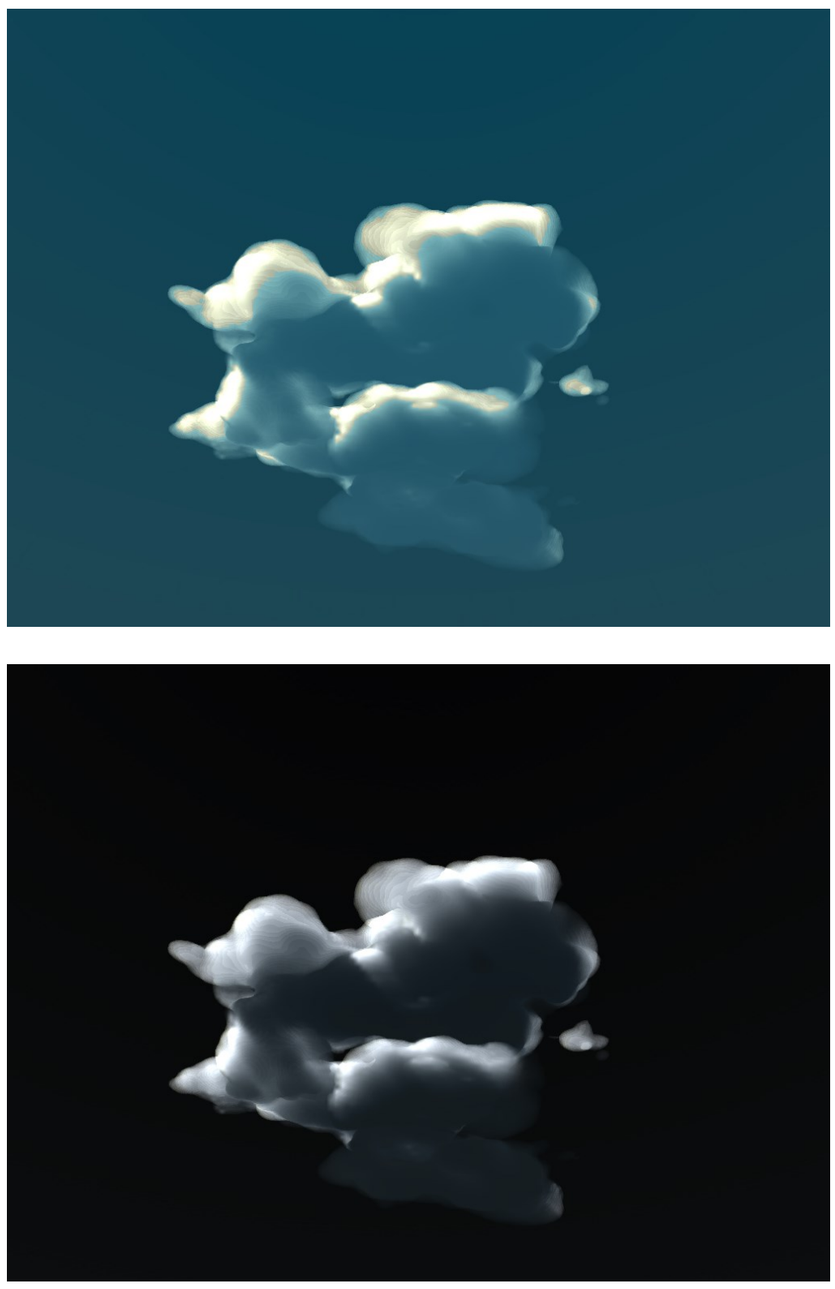

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Abstract

One of the hardest challenges of modern computer graphics is the rendering of complex objects in real-time. This thesis focuses on the rendering of clouds with the goal to achieve a realistic and good-looking cloudscape that can be rendered in real-time making use of OpenGL.

This project is heavily inspired by the techniques used for the rendering of the Volumetric cloudscape of Horizon: Zero Dawn, which was shown for the first time at SIGGRAPH 2015.

The use of volumetric billboards, two-dimensional elements that are shown on screen making use of geometry shaders, is the first technique that was implemented to achieve similar results. A more advanced technique to render complex elements like clouds is raymarching, this technique uses rays to detect collisions and adds up, in an iterative way, the color of the current element to build up the final color that will be shown on screen.

The final product is able to render in real-time moving and lit clouds at different times of the day, such as sunrise, noon, sunset, and nighttime in a scene that also features terrain.

Goals

The goals of the project were the following:

- Reading and understanding the state of the art on the topic and proposing an implementation plan using OpenGL and the graphics engine provided by the teacher.
- Implementing real-time 3D volumetric cloudscapes in the graphics engine.
- Write a simple demo that shows the implemented functionality.
- Analyze and compare results against other sources and the state of the art.

Conclusions

The generation of a cloudscape in real time using modern OpenGL is a really challenging topic, but all the required goals were met:

- The state of the art on the topic was broadly explored.
- The implementation of a real-time 3D volumetric cloudscapes in the graphics engine was successful and the ray marching technique was used to do that.
- A little demo was written in order to show the achieved results.
- The results were successfully compared with the current state of the art in the topic.

On top of that, the option to switch between different times of the day with a different skybox for each visualization, the ability to rotate the light direction, and terrain to show how the engine could potentially be used in the future were implemented.