

ENGINEERING THESIS

Game Level Building Techniques Using a Game Engine

Procedural Generation and Photogrammetry in Unreal Engine

Author: **Maciej Karczmarz**

Supervisor: Sławomir Samolej, PhD Eng., Prof. of PRz

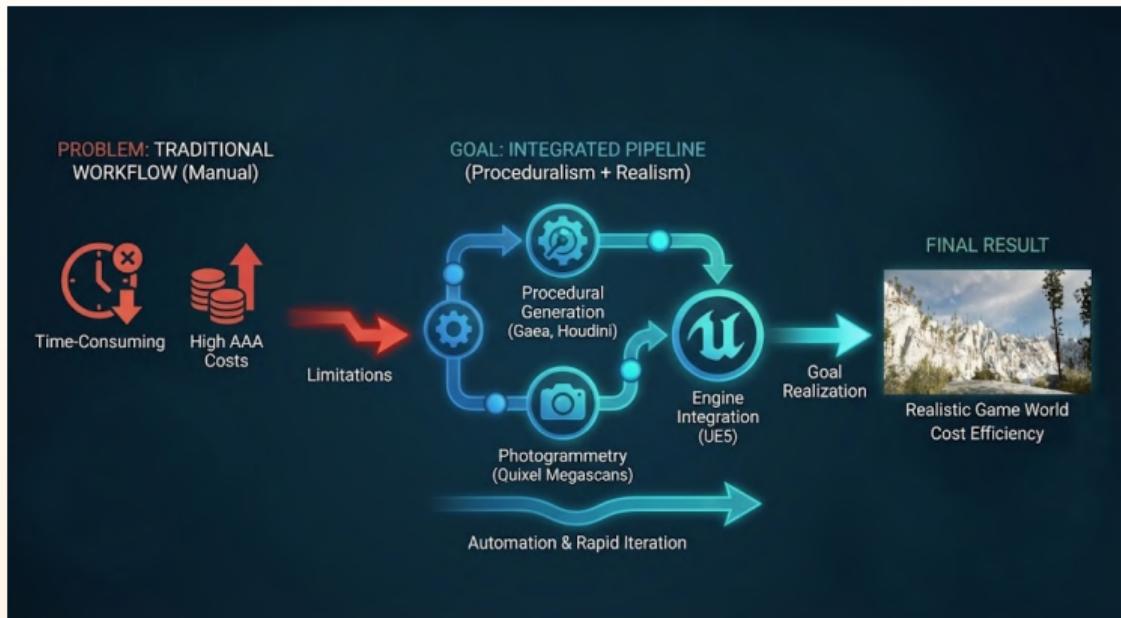
Research Objective and Problem

Problem:

- ▶ Time-consuming manual work.
- ▶ High AAA costs.

Thesis objective:

- ▶ Integrated pipeline.
- ▶ **Proceduralism + Realism.**



Technology Stack



**UNREAL
ENGINE**

Houdini™



GitLab



**Quixel
BRIDGE**



**Quixel
MEGASCANS**



Unreal Engine 5
Core & Render

Gaea
Terrain → Erosion

Houdini
Vegetation HDA

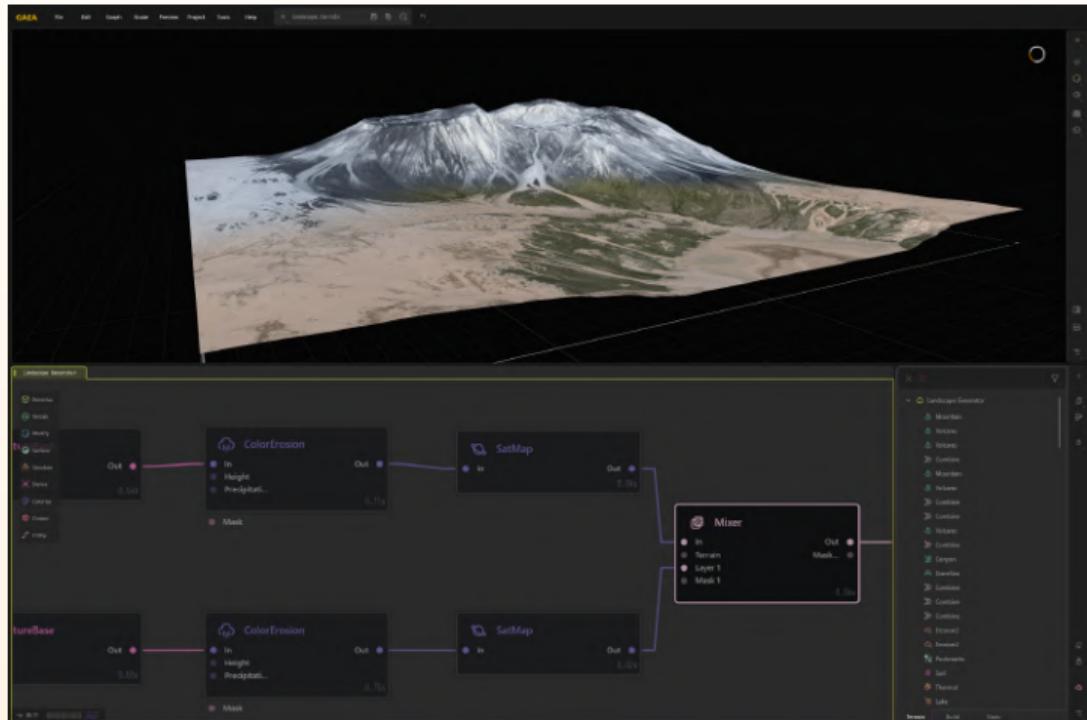
Quixel Tools
3D Scans

GitLab
Backup

Methodology: Terrain Generation (Gaea)

Process:

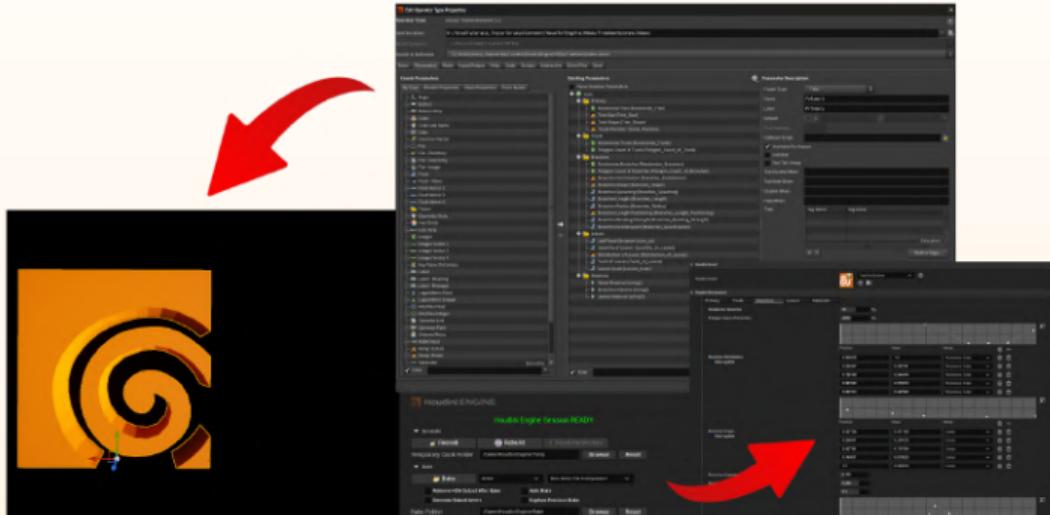
- ▶ Natural erosion simulation.
- ▶ Flow mask generation.



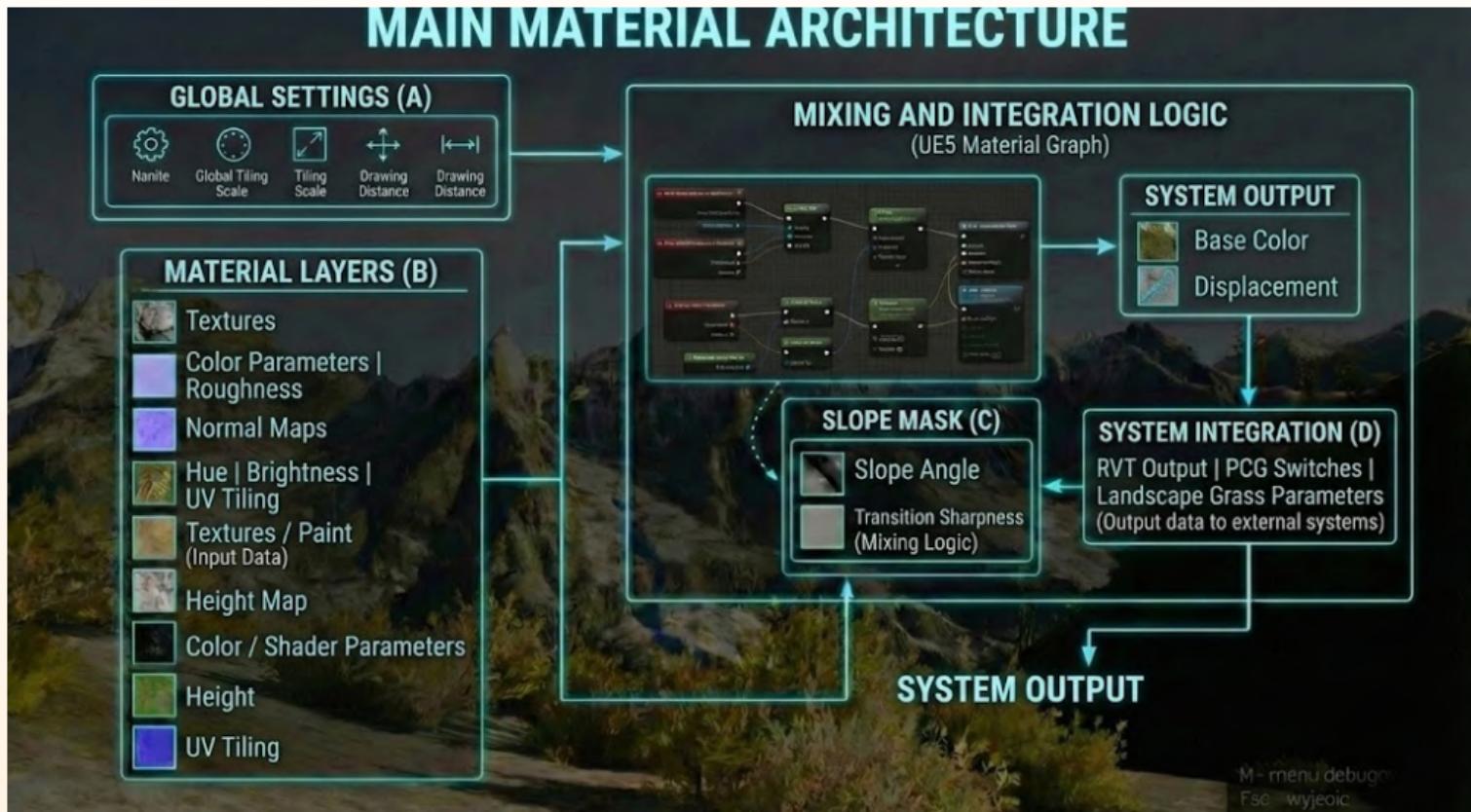
Methodology: Procedural Vegetation (Houdini)

Houdini Digital Assets (HDA):

- ▶ Creating "live" tools in UE5.
- ▶ Parameterization of vegetation density and type.



Logic: Auto Blend Material



Results: Three Biomes, One System



1. Sunny

Results: Three Biomes, One System



2. Desert

Results: Three Biomes, One System



3. Winter

Performance

30-36

FPS (1440p, Epic)

94%

VRAM Usage (8GB)

Technical Overview

USTAWIENIA-UPSCALING/AA	NVIDIA DLSS FRAME GENERATION	RTX DYNAMIC VIBRANCE
Rozdzielcość 1440p	Wsparcie DLSS-FG Supported	Tryb Wsparcia Supported
Upscaling NVIDIA DLSS	Tryby DLSS-FG Auto	Tryb Dynamic Vibrance On
USTAWIENIA GRAFICZNE	STATYSTYKI DLSS-FG	DYNAMIC VIBRANCE - STAT.
<input type="button" value="Włącz RTX"/> RTX ON	Min. Wersja Sterownika 512.15 Wykryta Wersja Sterownika 591.74 Min. Wersja Systemu Operacyjnego 10.0.19.041 Wykryta Wersja Systemu Operacyjnego 10.0.26.200 Wsparcie API D3D12 Wymagane Planowanie GPU true Aktywacja V-Sync true	Min. Wersja Sterownika 512.15 Wykryta Wersja Sterownika 591.74 Min. Wersja Syst. Oper. 10.0.0 Wykryta Wersja Syst. Oper. 10.0.26.200 Wsparcie API D3D11 D3D12
STATYSTYKI DLSS	STATYSTYKI KŁATEK NA SEKUNDĘ	
Min. Wersja Sterownika 470.0 Przestarzały Sterownik No Min./Max. Skalowanie Obrazu 50%/100%	Licznik FPS 32 Aktualny Licznik FPS 33	.
NVIDIA REFLEX	STATYSTYKI TRYBÓW DLSS	NVIDIA REFLEX - STAT.
Stale Skalowanie Obrazu No Min./Max. Skalowanie Obrazu 50%/100%	Wsparcie Reflex Supported Tryb Reflex Enabled	Min. Wersja Sterownika 512.15 Wykryta Wersja Sterownika 591.74 Min. Wersja Syst. Oper. 10.0.0 Wykryta Wersja Syst. Oper. 10.0.26.200 Wsparcie API D3D11 D3D12 Wym. Planowanie GPU false Aktywacja V-Sync false
LATENCY STATS		
		Opóźnienie Gry → Render 896.712 Opóźnienie Gry 450.679

Summary: Personal Contribution

Implementation and Logic:

- ▶ Development of a procedural pipeline (Gaea, Houdini → UE5).
- ▶ Creation of HDA tools in Houdini (vegetation).
- ▶ Implementation of a Master Material with an Auto Blend function.

Custom solution
for tool integration

Art & Design:

- ▶ Composition of three diverse biomes.

Summary: Conclusions and Future Work

Encountered problems and limitations

- ▶ High VRAM usage with 4K textures.

Perspectives for future work

- ▶ Optimization to improve performance.
- ▶ Adaptation of the pipeline for generating simulation environments (automotive/aviation).



Thank you for your attention