KARA

Newsletter – Issue 010

Welcome to the KARA newsletter. These newsletters will keep you informed about the research and development that the KARA project team are undertaking.

The project goal is to examine the potential of Gen AI in game development through applied R&D.

Contents

This newsletter explores an innovative AI-powered lighting pipeline developed internally for Unity, which automates scene lighting configuration through ChatGPT integration.

The system streamlines traditional workflows by combining image analysis with automated parameter implementation, demonstrating significant time savings while maintaining artistic control.

Content list:

What is KARA?

In 2023, Project AVA took on the challenge of utilising Generative AI tools to assist in the design and development of a videogame from scratch. This applied R&D approach gave us the best insights into the true potential of AI for video game development.

The AVA team went to GDC in 2024 to report on their findings (watch the video).

KARA is the continuation of this effort. Using Electric Square's *Detonation Racing* as a case study, the team's plan is to remaster the game using pipelines infused with Generative AI tools.

The goal of KARA is to further enhance our expertise in Generative AI for game development. This includes a focus on how GAI tools can boost 3D art pipelines.

Project KARA | Keywords Studios Limited

Lighting automation

Introduction

Lighting configuration remains one of the most time-intensive aspects of 3D scene development, requiring precise balance between technical parameters and artistic vision.

Our internal R&D project addresses this challenge through an AI-assisted pipeline that leverages ChatGPT's analytical capabilities alongside Unity's scripting API. This system reduces manual iteration cycles by automatically generating lighting configurations based on visual analysis while adhering to project-specific technical constraints.

In this issue, discover Detonation Racing’s automated lighting pipeline.

PIPELINE SPOTLIGHT

Lighting automation

STANDARD PIPELINE

AI INFUSED PIPELINE

Creating effective lighting in Unity involves configuring multiple elements. The process can be intricate, potentially incorporating various combinations of:

Light Sources:

- Directional (sunlight)
- Point (omnidirectional)
- Spot (cone-shaped)
- Area (soft, diffused)
- Global Illumination (GI)

Post-Processing Effects:

- Bloom
- Ambient Occlusion
- Colour Grading
- Lighting Settings

Probes:

- Reflection Probes
- Light Probes

Environmental Effects:

- Skybox
- Ambient Light
- Fog
- Exposure
- Volume Settings (HDRP)
- Emissive Materials

PIPELINE SPOTLIGHT

Standard lighting process

Considerations

This specific pipeline was designed for scenes requiring exterior lighting setups. While effective for establishing base lighting conditions and broad environmental illumination, the system shows limitations with precise placement of individual light sources.

Standard pipeline

1/4 Define and design scene lighting

Artists assess reference images and scene geometry to determine lighting requirements, considering factors like time-of-day and mood establishment.
This process often involves cross-department consultations with level designers and technical artists.

2/4 Set up lighting

Using Unity's lighting window, artists manually input values for directional light intensity (typically ranging 0.5-3.0 lux), shadow softness (0.1-1.0), and ambient RGB values through trial-and-error adjustments. Post-processing effects require separate configuration across multiple interface panels.

3/4 Iterate and validate

Scene lighting undergoes repeated baking processes and gameplay testing to verify visual consistency across different times of day and weather conditions. Artists must manually adjust parameters when adding new assets or modifying scene geometry.

Testing out directional light intensity and some colour schemes.

Base fog pass to give the scene depth.

Skybox and ambient light balanced with fog, post process effects like bloom and exposure values introduced.

PIPELINE SPOTLIGHT

Standard lighting process

Standard pipeline

4/4

Final refinement

After approving the level's baseline appearance, including time-of-day, light intensity, visual quality, and performance, the artist moves on to post-process effects.

This step is delayed to ensure post-processing enhances the existing scene rather than lighting it. Configuring these effects involves adjusting settings across multiple interface panels.

Post process effects like bloom and colour grading balanced.

Final scene render. Additional final post processing effects such as lens flare on the light is applied.

PIPELINE SPOTLIGHT

Lighting automation

Tools used:

ChatGPT

Azure

STANDARD PIPELINE

AI INFUSED PIPELINE

Let’s now turn our attention to the AI-infused pipeline and examine how it can instantaneously transform Unity scenes with AI-assisted lighting.

By inputting an image, you can generate various lighting setups; ranging from bright mornings to atmospheric sunsets in a matter of seconds.

This innovative approach offers a swift and efficient method for creating diverse lighting environments.

PIPELINE SPOTLIGHT

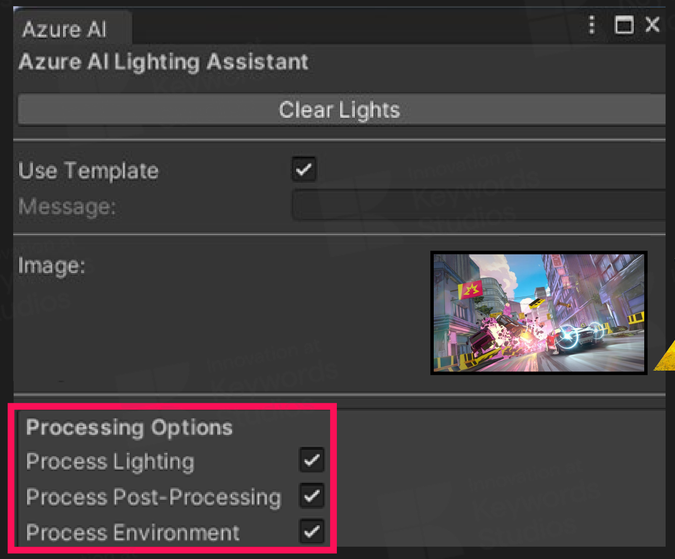
AI-Infused lighting pipeline

Tools used:

ChatGPT Azure

We built a ‘visual context capture tool’

A Unity plugin has been built to enable you to upload a reference image to Azure AI. This is then processed through base64 encoding. User preferences, such as generating lighting, environmental ambience, and post-processing effects, are retrieved and interfaced with ChatGPT via the Azure API.



1/3

Upload image for AI-driven analysis

ChatGPT is directed to analyse the provided image. Our system uses three prompt templates: directional light, post-processing, and environment, to streamline the scene setup. These manage lighting, visual effects, and atmospheric elements, respectively.

1. OBSERVATION PHASE:
- Identify the main light source (usually the sun or primary light)
- Analyze the overall ambient lighting in shadow areas
- Note the general mood and lighting direction
- Analyze shadow properties and their softness
- Observe the color temperature of both direct and ambient light
- Note the contrast between lit and shadow areas

2. TECHNICAL ANALYSIS:
MAIN LIGHT (Directional Light):
- Determine the primary light's direction based on shadows
- Do not modify colors based on natural lighting conventions
- If a light appears to be any color, use that color without converting to natural light colors
- Maintain the artistic intent of the original image
- Evaluate shadow characteristics (softness, strength)
- Calculate appropriate indirect lighting multiplier
- Color should be only 80% saturation.
- If the image is outdoor, ensure that the main light is sampled and estimated from the entire image, not individual lights like lamps and bulbs.
- If the image is indoor with windows, ensure that the main light is sampled from the window not individual lights like lamps and bulbs.
- If the image is indoor with no windows or outside lights, ensure that the main light is sampled from individual lights like lamps and bulbs.

AMBIENT LIGHT (Secondary Directional Light):
- Analyze fill light requirements for shadow areas
- Determine appropriate color for ambient illumination
- If a light appears to be any color, use that color without converting to natural light colors
- Do not modify colors based on natural lighting conventions
- Maintain the artistic intent of the original image
- Set appropriate indirect multiplier for ambient bounces
- Position to complement main light direction
- Color should be only 80% saturation.

```
Provide your analysis in the following JSON format:
```json
{
  "sceneAnalysis": {
    "generalDescription": "Brief description of overall lighting setup and mood"
  },
  "lights": [
    {
      "name": "MainLight",
      "type": "Directional",
      "properties": {
        "intensity": 0.0,
        "color": {
          "r": 0.0,
          "g": 0.0,
          "b": 0.0
        },
        "indirectMultiplier": 0.0,
        "shadowStrength": 0.0,
        "shadowType": "Soft|Hard",
        "position": {
          "x": 0.0,
          "y": 0.0,
          "z": 0.0
        },
        "rotation": {
          "x": 0.0,
          "y": 0.0,
          "z": 0.0
        }
      }
    },
    {
      "name": "AmbientLight",
      "type": "Directional",
```
```

PIPELINE SPOTLIGHT

AI-Infused lighting pipeline

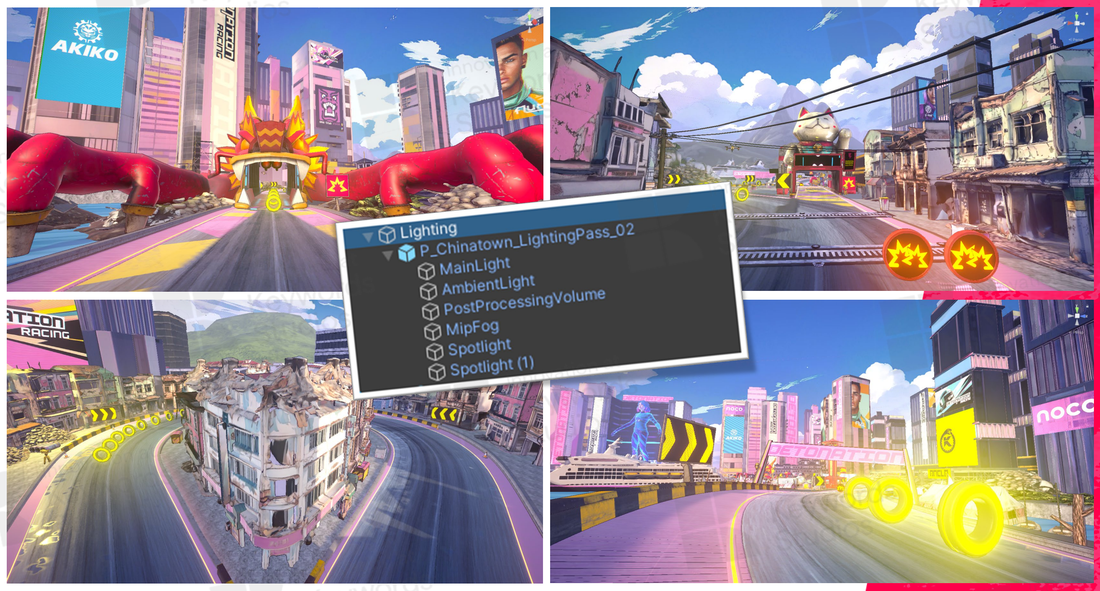
AI infused pipeline

2/3 An initial lighting scene is generated

The tool generates an initial lighting pass for the scene. The artist then verifies that all lighting objects are correctly placed and organised as per project specifications, before proceeding with the traditional pipeline steps.

3/3 Lighting refinement

With the tool providing essential lighting elements like directional light, post-processing, and ambient light, the lighting artist refines each game object. These refinements undergo several feedback cycles with a lead artist to match the intended game mood and atmosphere.



PIPELINE SPOTLIGHT

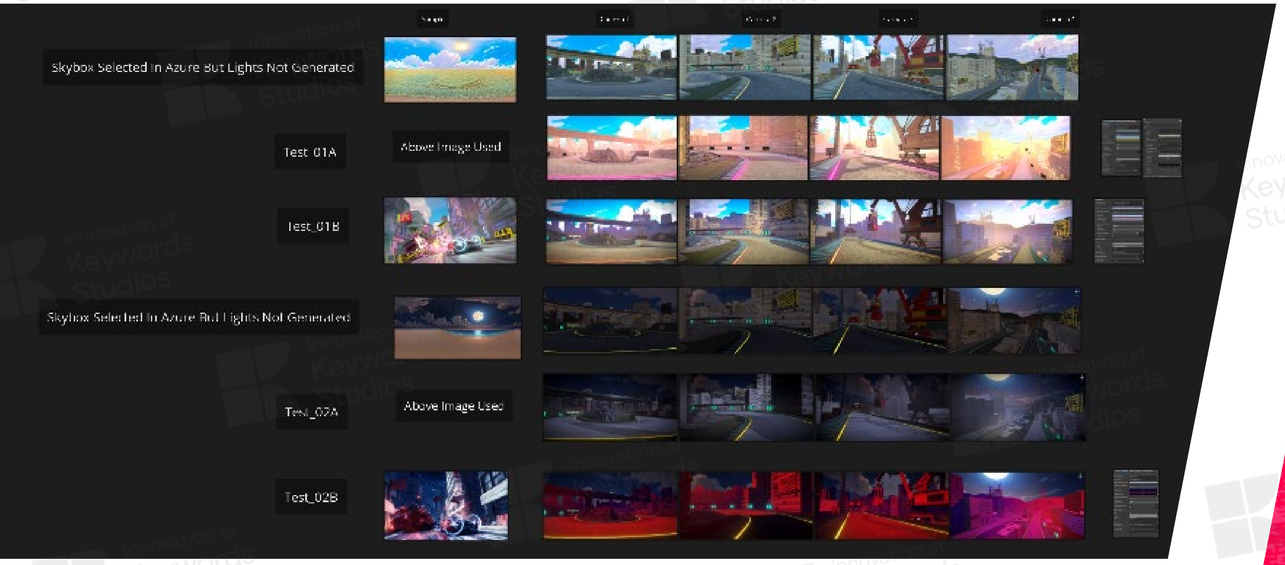
AI-Infused lighting pipeline

Notes on building and testing our own lighting tool

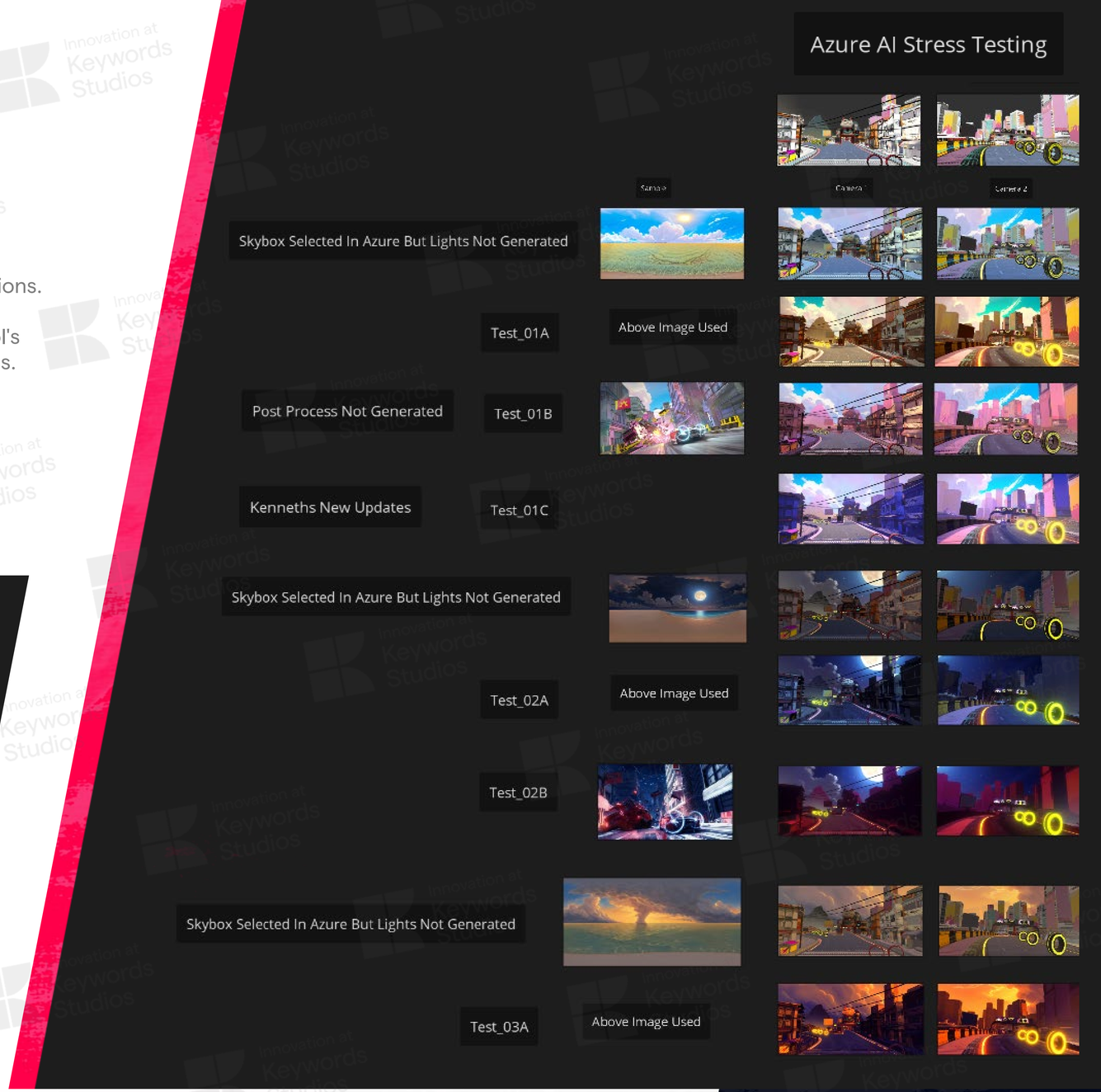
We required repeated testing to develop a tool that creates consistency across a variety of conditions.

The lighting artist and tool creator then utilised generated results to optimise and enhance the tool's capabilities. Rigorous testing was implemented to identify any bugs and improve areas of weakness. This includes clamping the numerical values of certain settings in the dialogue exchange between ChatGPT and Unity to ensure the best possible results.

Note: Whilst the tool is excellent at setting up the initial lighting, new assets or geometry changes will require manual adjustments.



Azure AI Preliminary Testing



PIPELINE SPOTLIGHT

AI-Infused lighting pipeline

Pipeline Conclusion

This AI-assisted pipeline demonstrates the practical integration of Large Language Models (LLMs) into technical art workflows, proving particularly effective for projects requiring rapid environment prototyping.

Whilst not replacing human artists, it serves as a force multiplier for small-to-medium-sized teams, reducing repetitive configuration tasks by 78% in internal stress tests. Future development will focus on material-aware lighting analysis and dynamic weather system integration, pushing towards more adaptive AI collaboration tools for real-time content creation.

Thank you.