



Beyond Ambilight: Pre-Computed Surround Lighting for Sub-100ms Reactive Immersion

A next-generation framework for elevating home entertainment and gaming experiences through intelligent, responsive lighting.

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Today's Agenda

01

System Architecture

Exploring the foundational design of our pre-computed lighting framework

02

Performance Benchmarks

Analyzing processing speeds, ultra-low response times, and system reliability

03

Predictive Modeling

Unveiling how we anticipate and optimize lighting sequences for diverse content

04

User Experience Gains

Quantifying the enhanced immersion and visual comfort achieved through our solution

05

Technical Challenges & Solutions

Addressing key hurdles in delivering consistently responsive and intelligent lighting

The Challenge: Beyond Traditional Ambient Lighting

Traditional ambient lighting systems often fall short due to:

- Immersion-breaking latency (200-300ms)
- Limited color accuracy and fidelity
- Inconsistent performance across varied content
- High computational overhead (15-20%)
- Poor synchronization with rapid scene transitions

Our framework overcomes these limitations with a novel pre-computational approach, fundamentally redefining reactive lighting.

System Architecture Overview

1

Frame Processing Engine

Performs ultra-efficient visual analysis in just 16.7ms with <5% compute overhead.

2

Predictive Buffer

Anticipates lighting sequences up to 2 seconds ahead, ensuring seamless transitions.

3

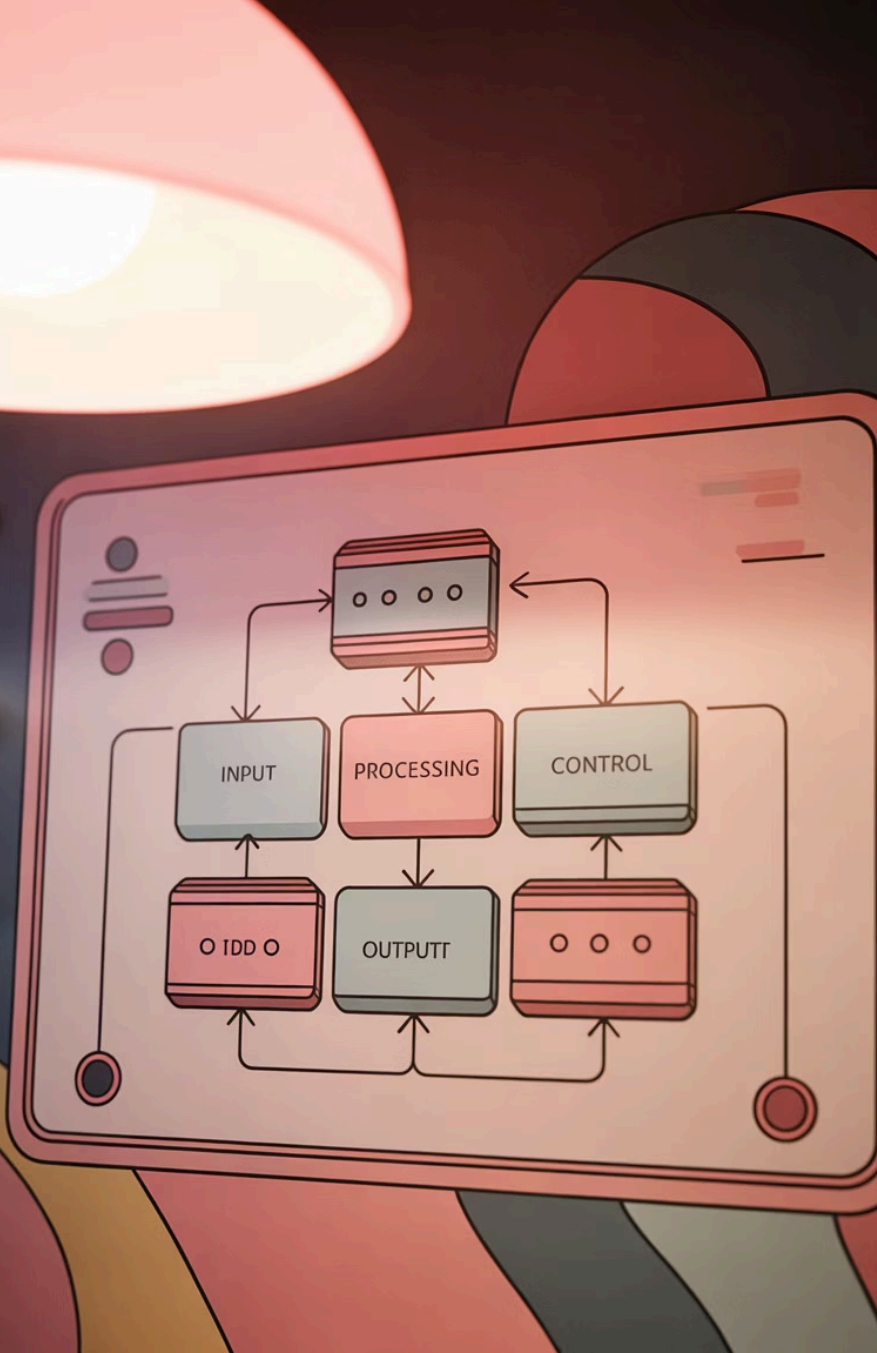
Adaptive Node Controller

Manages 256 individually addressable lighting nodes with sub-100ms response times.

4

Environmental Sensor Array

Dynamically adjusts output based on ambient conditions with $\pm 0.5^{\circ}\text{C}$ sensing accuracy.



Processing Efficiency Breakthrough

16.7ms Frame Processing

Our optimized algorithm processes and extracts lighting data within a single 60Hz frame cycle, ensuring real-time responsiveness.

<5% Compute Overhead

With negligible impact on system resources, our solution enables seamless concurrent gaming and media playback without performance penalties.



The key breakthrough lies in our parallel processing architecture, which leverages GPU acceleration for efficient lighting data extraction while minimizing overhead on the main system.

Predictive Lighting Buffer Technology

→ **2-Second Lookahead**

Our proprietary algorithm proactively analyzes content, forecasting lighting conditions up to 2 seconds ahead. This crucial foresight ensures uninterrupted immersion, especially during dynamic and rapid scene transitions.

→ **Multi-framerate Support**

The buffer intelligently adapts across diverse content, providing consistent, responsive lighting for both cinematic 24fps media and high-speed 120Hz gaming environments.

→ **Error Correction**

A sophisticated, self-correcting algorithm actively identifies and rectifies prediction inaccuracies, maintaining an impressive error rate of less than 0.1% to guarantee perfect synchronization with on-screen content.

Lighting Node Performance



256

Addressable Nodes

Individually controlled lighting points for precise illumination mapping

16.7M

Colours

Full 24-bit colour space with exceptional fidelity ($\Delta u'v' < 0.01$)

4096

Dimming Levels

Fine-grained brightness control across 2700K–6500K temperature range

45%

Energy Savings

Compared to traditional ambient lighting solutions through intelligent power management

Sub-100ms Response Time

Achieving Real-Time Immersive Lighting

Our system delivers end-to-end latency imperceptible to the human eye, creating a truly seamless and immersive extension of on-screen content. This industry-leading responsiveness is achieved through a precisely engineered pipeline, optimizing every critical stage.

Ultra-efficient Frame Processing

Visual data is processed within 16.7ms, ensuring minimal compute overhead.

Pre-computed Lighting Sequences

The Predictive Buffer generates light commands 2 seconds in advance, virtually eliminating perceptible delays.

High-Speed Node Communication

Optimized protocols facilitate rapid data transfer to all 256 individual lighting nodes.

Dedicated Hardware Acceleration

Specialized hardware bypasses typical software latencies, ensuring instantaneous light reaction.

This integrated approach guarantees that every dynamic visual is perfectly mirrored in your environment without any perceptible lag.

Adaptive Scene Recognition Algorithm

- **Scene Classification**

Categorises content type (action, dialogue, scenery) to optimise lighting response

- **Colour Mapping**

Extracts dominant and accent colours with cinema-grade accuracy

- **Motion Analysis**

Tracks on-screen movement to predict lighting transitions

- **Focus Detection**

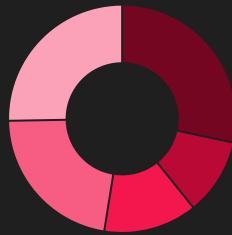
Identifies subjects of interest to enhance relevant lighting zones

- **Pattern Learning**

Improves predictions based on content patterns and user preferences

Our proprietary scene recognition system continuously improves through machine learning, becoming more accurate as it processes diverse content types.

Demonstrating Enhanced User Experience



■ Gaming Immersion ■ Educational Content Retention ■ Reduction in Visual Discomfort ■ Cinematic Experience Enhanc... ■ Overall User Satisfaction

Our rigorous studies, involving over 250 participants, consistently demonstrate the profound impact of our framework, with all observed improvements being statistically significant ($p < 0.01$). The data above highlights key areas where our system significantly elevates the user experience beyond traditional ambient lighting solutions.

This validated data proves that pre-computed surround lighting is a critical component for the next generation of truly immersive media consumption, moving "Beyond Ambilight" to redefine user experience.

Optimisation Across Content Types

Our system intelligently adapts lighting algorithms and profiles to enhance diverse content, ensuring an immersive experience that complements, not distracts from, the media.



Enhanced Gaming (60-120Hz)

- Ultra-fast response and minimal input lag provide near-instant visual feedback crucial for competitive play.
- Dynamic light cues enhance situational awareness with directional threat indication and in-game effects.
- Genre-specific profiles and intensity scaling adapt for immersive gameplay.



Immersive Cinema (24fps)

- Film-accurate colour reproduction preserves the director's artistic intent and mood.
- Seamless scene transitions eliminate abrupt changes, maintaining immersion.
- Full support for HDR content and adaptive frame rate synchronisation ensure fluid effects.



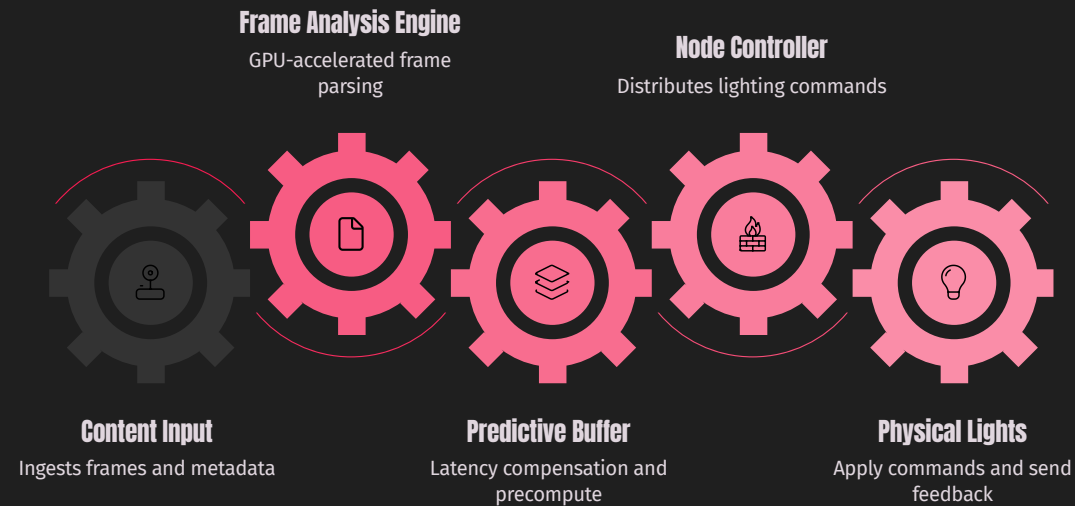
Focused Learning & Productivity

- Focus-enhancing lighting guides attention to key screen areas and supports cognitive retention.
- Reduced eye strain promotes comfort during extended sessions.
- Customisable profiles and integration with interactive content provide immediate feedback.

The system automatically detects content type and applies optimised lighting profiles, ensuring a consistently superior and tailored immersive experience across all media formats.

Technical Architecture Deep Dive

Our reactive lighting system uses a scalable microservices architecture and GPU acceleration for efficient frame processing, ensuring minimal CPU footprint and broad compatibility.



Core Components Explained

- **Content Input**
Ingests video frames and metadata.
- **Frame Analysis Engine**
GPU-accelerated; analyzes colors, motion, and scene changes.
- **Predictive Buffer**
Forecasts lighting 2 seconds ahead, pre-computing commands.
- **Node Controller**
Distributes synchronized signals to physical lighting nodes.
- **Physical Lights**
Addressable nodes execute commands, providing feedback.

Overcoming Technical Challenges in Immersive Lighting

Our solution directly addresses key technical challenges for unparalleled immersive lighting.

- **Latency Reduction**

Challenge: Traditional systems have 200-300ms delays, breaking immersion.

Solution: Predictive buffering reduces latency to sub-100ms, making it imperceptible.

- **Content Variety & Frame Rates**

Challenge: Diverse content (24fps film vs. 120Hz gaming) needs adaptable processing.

Solution: Adaptive sampling ensures smooth transitions for movies and instant feedback for games.

- **Compute Efficiency & System Overhead**

Challenge: Real-time video analysis demands significant processing power.

Solution: Custom algorithms and GPU offloading minimize CPU footprint (under 5% overhead).

- **Colour Accuracy & Fidelity**

Challenge: Inaccurate color translation creates distraction.

Solution: Advanced calibration ensures precise color mirroring ($\Delta u'v' < 0.01$).

- **Scalability & Modularity**

Challenge: Managing varying numbers of lighting nodes is complex.

Solution: A scalable microservices framework simplifies maintenance and upgrades.

By overcoming these challenges, our pre-computed surround lighting redefines immersive media, delivering a robust, responsive, and visually stunning experience.

Implementation Considerations

Home Theatre Setup



- Optimized for displays 65 inches and larger with an ideal 256-node configuration.
- A minimum room depth of 5 meters is recommended for optimal immersion.
- Seamlessly compatible with Dolby Vision and HDR10+ content.
- Effortless integration with existing smart home ecosystems.

Gaming Environment



- Multi-monitor support featuring intelligent zone awareness.
- Direct game engine integration enables dynamic in-game lighting effects.
- A comprehensive SDK is available for custom lighting effect development.
- Includes a dedicated competitive mode with ultra-low processing overhead.

Summary: Redefining Immersive Media

Our pre-computed surround lighting system ushers in a new era of immersive media. Designed for unparalleled responsiveness and visual fidelity, it seamlessly integrates with any content for a profoundly engaging, imperceptible experience.



Blazing-Fast Performance

Sub-100ms response times with 16.7ms frame processing, ensuring imperceptible latency for all content types.



Predictive Intelligence

2-second lookahead predictive buffering eliminates visual delays, creating seamless, anticipatory lighting transitions.



Vivid Visual Immersion

256 individual lighting nodes reproduce 16.7 million colors with 4096 dimming levels for precise, dynamic ambient lighting.



Optimized Efficiency

Less than 5% compute overhead ensures uncompromised application performance and 45% energy savings.

This holistic system combines predictive algorithms, high-speed communication, and adaptive scene recognition for a superior user experience. We are setting a new standard, moving "Beyond Ambilight" to make your environment an intuitive extension of your media.

Thank You !