

# Illuminating Memory: Using Ambient Light to Enrich Generative Representations of Daily Life

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## Abstract

People increasingly record their lives through smartphones, yet most digital traces capture only what happened rather than how it felt. We explore how generative multimodal media, particularly ambient lighting, can expand digital records beyond simple descriptions and reintroduce sensory and emotional depth into digital memory. We present a system that matches smartphone-sensed experiences with generative video clips and enriches them with ambient lighting derived from large language model outputs. In an evaluation study, participants viewed personalised videos representing moments from their daily lives under different lighting configurations. Simple lighting patterns significantly shaped interpretation and emotion, with single-colour lighting being perceived as calm and authentic, while more complex transitions were expressive but sometimes distracting. These results show that ambient light offers a subtle but influential cue for atmosphere and reflection, suggesting new possibilities for multisensory lifelogging and digital memory.

## CCS Concepts

• **Human-centered computing** → **Interaction design theory, concepts and paradigms.**

## Keywords

Ambient Light, Multimodal Interaction, Generative Media, Digital Memory, Smartphone Sensing

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## 1 Introduction

Human memory is multisensory. When we recall everyday moments, we remember not just events but also their atmospheres, including light, colour, and feeling. Yet, most digital lifelogging and journalling systems reduce these experiences to text or static visuals such as diaries and screenshots. These representations can capture what happened, but not necessarily how it felt.

This work explores how generative multimodal media can bridge that gap. We present a system that links smartphone sensing data with short generative clips accompanied by ambient lighting patterns, extending recollection beyond the sight and sound of audiovisual content to include light as a medium of affect and memory.

In an in-lab study, participants viewed generative audiovisual clips representing their own sensed daily activities under three lighting configurations: one-colour pulses, two-colour transitions, and three-colour transitions. They rated and discussed how each condition shaped emotional resonance, immersion, and visual appeal.

Our findings show that even simple lighting patterns can meaningfully alter interpretation and connection. Participants often described single-colour lighting as calm and focused, while multi-colour transitions evoked mood shifts or narrative progression. These findings suggest that ambient light can serve not merely as decoration, but as a perceptual and emotional bridge between data and everyday experience. By integrating light, audio, and video into a unified generative framework, we demonstrate how everyday moments can be reconstructed as atmospheric experiences rather than purely factual records, offering new possibilities for sensory lifelogging and digital memory.

## 2 Related Work

### 2.1 Capturing and Reliving Digital Experiences

The human desire to document personal experiences dates back millennia, from cave paintings and hieroglyphs to diaries, photo albums, and home movies. Preservation of everyday moments intensified with the 1970s quantified-self movement [3], as people began systematically tracking their lives through journals and early digital tools.

Smartphones represent the latest stage in this evolution, turning documentation into a continuous and often passive process. Equipped with diverse sensors and logs, they capture multiple facets of daily life, from physical activities [4] and location tracking [7] to behavioural patterns [15, 25, 26]. Modalities capturing general smartphone use, such as app analytics [31] and keystroke dynamics [1], further reveal interaction behaviour. Recent tools also record digital content directly, including the Screenomics framework [19], which captures periodic screenshots to study engagement, and the screen text sensor [24], which logs on-screen text in real time to create detailed portraits of users' digital lives.

Advances in context inference and large language models (LLMs) now enable automatic generation of personal journals. Smart Diary [14] inferred activities from mobile sensors, AutoLife [29] used LLMs with commonsense reasoning to create narrative diaries, and AutoJournaling [30] applied multimodal LLMs to analyse screenshots and produce reflective narratives combining events and emotions. LLMs have also enabled human-AI collaborative journalling, with DiaryMate [12] acting as a co-writer and MindfulDiary [10] extending this concept to therapeutic reflection. Together, these systems mark a shift from smartphones as passive data collectors to active agents in interpretive journalling.

Despite these advances, these systems remain largely text-based, limiting the sensory and affective depth of reflection. Text and static imagery alone cannot convey the extensive range of sounds, emotions, and atmospheres that shape everyday experiences. Bridging lifelogging and multimodal media thus offers an opportunity to move beyond descriptive records toward representations that evoke how experiences feel, not merely what occurred.

## 2.2 Multimodal Experience Generation

The proliferation of multimodal interfaces has enabled new ways to re-imagine personal experiences through multiple senses. Unlike text- or image-based journalling, these approaches create embodied recollections that engage users more directly. This draws on the concept of multiple sensorial media, which integrates sensory channels beyond sight and sound into cohesive experiences [9]. Engaging multiple senses enhances emotional resonance and presence, with cross-modal integration improving realism and affective engagement [20].

Interactive multimedia research has explored diverse sensory combinations to evoke immersion. Raheel et al. [18] synchronised a heater, fan, scent dispenser, and haptic vest with video playback, allowing users to feel heat, breeze, vibration, or scent linked to onscreen events. Human-centred projects have similarly used peripheral cues, such as light and spatial sound, to extend media into the environment. Drift Table [5] encouraged reflection on everyday life, while Memory Boxes [17] showed how physical artefacts and ambient media can trigger recollection. Coordinated visual, auditory, and tactile cues have also been shown to heighten emotional intensity and recall [16, 22].

However, there is limited work examining how different multi-sensory elements influence people's interpretation of their own everyday experiences. Prior multiple sensorial media systems demonstrate the expressive potential of combining modalities such as sound, touch, and light, but rarely evaluate how these cues affect

emotional response, immersion, or reflective engagement with personal content. In particular, the role of ambient light as an affective and interpretive element in representations of daily life remains underexplored. Our work addresses this gap by exploring how variations in lighting shape users' perceptions of depictions of their everyday experiences.

## 3 Method

Our goal was to evaluate ambient light as a modality that enriches generative representations of everyday experience. To isolate the contribution of lighting, we used a public online stimulus set of 1,000 ten-second generative audiovisual clips depicting common daily activities [23]. This dataset provided broad coverage of everyday scenes while allowing lighting to vary independently of audiovisual content. Building on this dataset, we implemented a two-part pipeline: generating ambient lighting configurations from video prompts using the Gemma 3 LLM [6], and deploying these configurations via programmable LED light strips integrated into the playback environment. This approach enabled synchronised audiovisual-lighting experiences for subsequent user evaluation.

### 3.1 Lighting Generation

Building on the existing video dataset, we generated lighting configurations corresponding to each video prompt to represent the emotional and atmospheric tone of everyday scenes. Using Gemma 3, we produced lighting parameters for each video in the form of ambient colours, expressed as three RGB values representing the dominant emotional palette of the scene. Each video prompt from the dataset was provided to the model using structured natural language instructions to generate vivid, distinct, and saturated LED colours that would best enhance the emotional tone of the described activity. The model was explicitly instructed to avoid pale, pastel, near-white, or desaturated tones, and to ensure that the three selected colours were visually distinct. The full instruction prompt is provided in the Appendix.

The resulting lighting configurations were stored alongside each video's existing metadata, including the original text prompt and associated audio prompts. This produced a dataset linking each modality, including video, audio, and lighting. Together, these outputs served as the basis for the user-facing stimuli used in the evaluation study.

### 3.2 Lighting Playback System

To render the lighting in real time, we integrated addressable LED light strips along the rear edge of a monitor, which was positioned with its back facing the wall so that the light diffused softly across the surface. A custom Flask application controlled the LEDs via a local network connection, synchronising colour transitions with each ten-second video. The system received the model's RGB output and applied the specified colours for the video duration before fading to black.

Three lighting modes were implemented to vary visual richness while keeping audiovisual content constant. In the single-colour condition, the dominant hue pulsed slowly over time. The two-colour condition alternated between the first and second colours with a smooth temporal gradient, while the three-colour condition

transitioned sequentially with a smooth temporal gradient across all three hues. Together, these configurations provided increasing visual complexity for evaluating how lighting variation influenced participants' perception and emotional engagement.

## 4 Evaluation

We conducted an in-lab user study to examine how participants perceived generated ambient lighting as representations of their own daily experiences, focusing on both experiential fidelity and emotional engagement.

Ten participants (5 male, 5 female) took part in a two-day study. On Day 1, participants installed the AWARE application [28] on their smartphones to collect behavioural and contextual data, including on-screen text, device state, keyboard activity, app usage, notifications, connectivity, and location. On Day 2, participants attended an in-person lab session where personalised generative content representing the previous day's activities was presented.

### 4.1 Personalised Clip Selection

Using the data captured from their smartphones in Day 1, we identified four short periods reflecting distinct parts of each participant's day. For each period, we selected a ten-second generative clip that best matched the inferred context. Participants first completed a brief reconstruction warm-up [8] to aid recall, followed by the ambient lighting evaluation. Sessions were conducted in a dimly lit room with the LED setup described earlier (Figures 1 and 2). Each session lasted approximately one hour, and participants received a \$40 gift card as compensation. The study was approved by the University of Melbourne's Office of Research Ethics and Integrity.

### 4.2 Ambient Lighting Evaluation

For each of the four selected moments per participant, the same generative audiovisual clip was presented under three lighting configurations: single-colour, two-colour, and three-colour transitions. The clip's audio and video were identical across the three trials, and only the lighting pattern changed. This within-clip design allowed participants to attribute differences in experience to lighting, rather than to differences in the underlying content. Participants rated each lighting configuration on three dimensions, consisting of *emotional impact*, *immersion*, and *visual appeal*, using a seven-point Likert scale, then ranked the three lighting configurations by overall preference. A screenshot of the ranking interface is included in the Appendix.

### 4.3 Reflection Interview

Following both phases, participants took part in a semi-structured interview exploring their broader impressions of the multisensory experiences. Questions addressed potential contexts of use, which modality (visuals, audio, or lighting) most strongly influenced their sense of connection to the depicted moment, and whether the lighting affected their experiences positively or negatively.

## 5 Results

We analysed how participants perceived the three lighting configurations generated from their top-ranked videos.

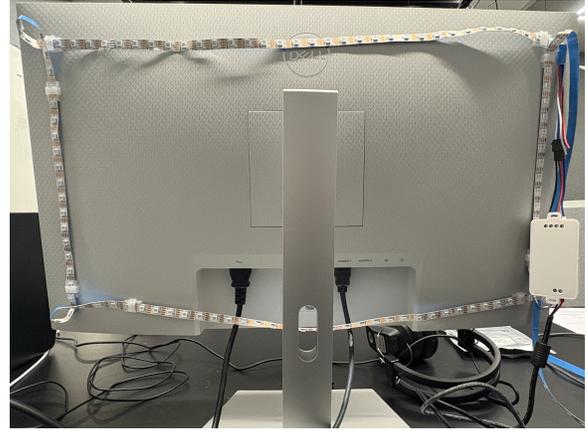


Figure 1: Rear view of the monitor with LED strip placement.

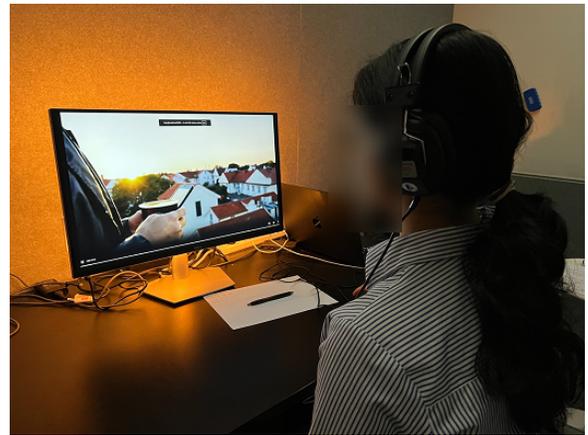


Figure 2: Participant viewing video stimuli during evaluation.

### 5.1 Lighting Preferences

A linear mixed-effects model predicted user rank from lighting configuration and subjective ratings (emotion, immersion, appeal), with random intercepts for participants. As displayed in Table 1, immersion ( $\beta = -0.14$ ,  $p = .049$ ) and appeal ( $\beta = -0.14$ ,  $p = .033$ ) significantly predicted better rankings, while emotion did not. Configuration contrasts were non-significant, indicating that preference depended on perceived immersion and appeal rather than strictly the number of colours.

As shown in Figure 3, one-colour lighting was most frequently ranked first (50% of all trials), two-colour lighting was usually ranked second (52.5% of all trials), and three-colour lighting most often ranked last (55% of all trials). Figure 4 shows the corresponding subjective ratings, where the one-colour lighting scored highest overall, especially for appeal, two-colour lighting held intermediate ratings, and three-colour lighting scored lowest.

Overall, participants preferred simpler configurations. One-colour lighting was rated and ranked highest, while ratings declined with each additional colour, with three-colour lighting rated lowest. However, preferences were driven by the perceived increased appeal and

**Table 1: Linear mixed-effects model predicting user rank from lighting configuration and subjective ratings.**

Predictor	Coef.	Std. Err.	z	p	95% CI
Intercept	3.332	0.256	12.99	< .001	[2.830, 3.835]
Two Colours (vs. One)	-0.200	0.145	-1.38	0.168	[-0.485, 0.084]
Three Colours (vs. One)	0.142	0.152	0.94	0.349	[-0.156, 0.441]
Emotion	-0.054	0.069	-0.79	0.428	[-0.189, 0.080]
Immersion	-0.142	0.072	-1.97	0.049	[-0.282, -0.001]
Appeal	-0.139	0.065	-2.14	0.033	[-0.267, -0.011]
Group Var	0.026	0.065			

immersion of a simpler configuration, rather than the complexity itself.

## 5.2 Participant Perceptions

Participants expressed nuanced and context-dependent views on lighting. Most acknowledged its potential to enhance immersion but noted that its effect depended on colour choice, contextual fit, and transition smoothness. When well-aligned, lighting amplified the emotional tone of videos, though it became distracting when there was a mismatch.

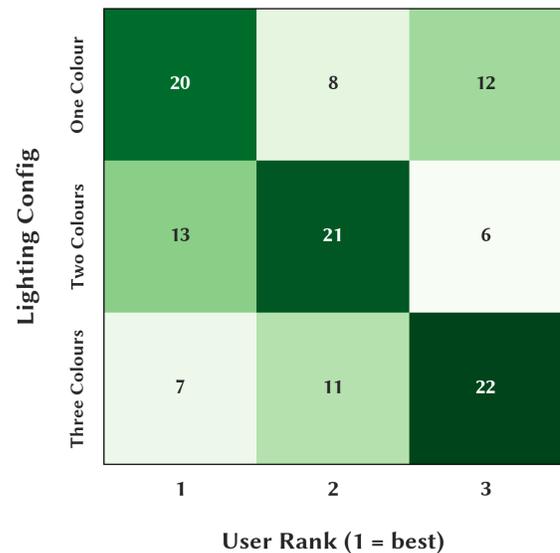
Several participants described lighting as a powerful amplifier of emotion. P1 noted that “when it’s done right, it amplifies the emotion or narrative that the video is trying to tell”, while P3 observed that “lighting complemented audio to create immersion”. In contrast, abrupt or poorly matched lighting was seen as intrusive, where three-colour patterns were described by P4 as “distracting, abrupt, and jarring”, and P10 commented that “wrong colours or rapid shifts are distracting”. Preferences were also context-driven, where calm or focused moments suited simpler lighting, while dynamic scenes benefited from variation. P3 reflected that they “preferred multiple shifting colours to match the energy of social settings like having beer with friends”, whereas P8 favoured “one-colour lighting during work periods for focus”.

Lighting was rarely perceived as meaningful on its own but played a strong mood-setting role. Participants ranked it as secondary to video, yet often as influential as or even more than audio in shaping atmosphere (P1, P3, P10). For some, it supported ambient reflection, with P3 describing that they would “use this before bedtime, as the lighting makes it relaxing and reflective”.

## 6 Discussion

Our findings show that even minimal variations in ambient lighting can meaningfully shape how people interpret and emotionally connect with generative representations of their daily lives. Participants’ preference for single-colour lighting suggests that simplicity can enhance focus and emotional clarity, while more complex transitions, though visually engaging, often introduce distraction or cognitive overload. This balance between stimulation and subtlety reflects broader work in ambient media design, where peripheral cues are most effective when they complement rather than compete with primary content [2, 27].

The strong influence of perceived immersion and appeal on user rankings highlights that the experiential quality of the lighting mattered more than its technical complexity. Participants judged

**Figure 3: Heatmap of user-assigned ranks across lighting configurations.**

configurations not by the number of colours, but by how well they harmonised with the underlying mood and activity. Here, lighting acted less as an isolated stimulus and more as an interpretive layer that can amplify, soften, or reframe the affective tone of a moment [11, 21].

These results suggest that ambient light can serve as a light-weight yet expressive medium for digital memory and reflection [13]. By aligning lighting with audiovisual representations of everyday life, such systems could evoke atmosphere and emotion in ways that text or static imagery alone cannot. Future work may extend this approach to adaptive or interactive systems that tailor lighting dynamically to context or user state, exploring how multisensory synthesis can further enrich reflection and wellbeing.

## 7 Conclusion

This work introduced a generative multimodal system that extends audiovisual representations of smartphone-sensed experiences with ambient lighting as an affective dimension. Through an in-lab evaluation study, we found that even simple lighting patterns can meaningfully alter how people interpret and emotionally connect with

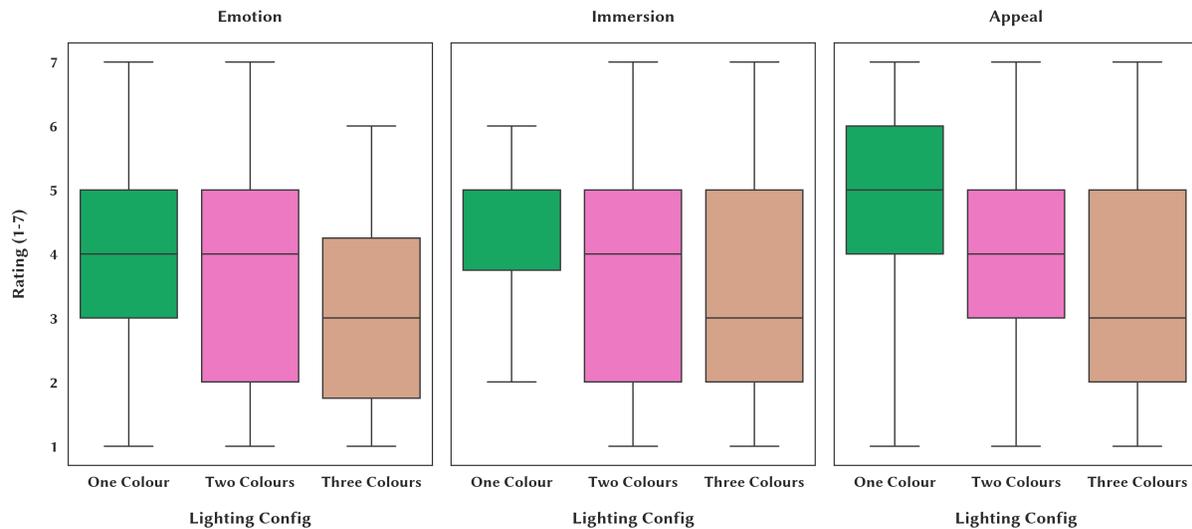


Figure 4: Subjective ratings (emotion, immersion, appeal) by lighting configuration.

representations of their daily lives. Participants preferred single-colour lighting for its calmness and clarity, while multi-colour transitions were valued when contextually aligned but sometimes seen as distracting.

Our findings highlight the potential of ambient light as a subtle yet expressive medium for reflection and digital memory. However, the study was limited by its small sample size, short exposure period, and controlled lab setting. Future work could explore adaptive, personalised lighting that evolves with user mood or context, and evaluate such systems in naturalistic, long-term deployments to better understand their role in everyday reflection and wellbeing.

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## A Lighting Colour Generation Instruction Prompt

The following instruction prompt defines the procedure used to generate lighting colour suggestions for video clips. It specifies the desired characteristics of the colours, ensures consistency across scenes, and constrains the model’s output to a structured JSON format.

**Instruction:** You have a 10-second video clip with this description: *{video\_prompt}*

- Suggest the top three vivid, saturated LED ambient light colours that would best enhance the emotional tone or atmosphere of this scene.
- Ensure all three colours are visually distinct and not just variations of the same hue.
- Avoid pale, pastel, near-white, or desaturated tones.
- Return only a JSON array of three RGB arrays like `[[r1, g1, b1], [r2, g2, b2], [r3, g3, b3]]`.
- Each RGB array must contain three integers between 0 and 255.
- Do not explain, and return only the JSON array.

## B Lighting Evaluation Interface

Participants completed the lighting evaluation using the interface shown in Figure 5. The interface contains three statements on a seven-point Likert scale:

- (1) **Emotional Impact:** The lighting enhances the emotional impact of the video.
- (2) **Immersion:** The lighting increases my sense of immersion in the video.
- (3) **Visual Appeal:** The lighting is visually appealing overall.

The cards can be dragged and dropped to rank the lighting setups.

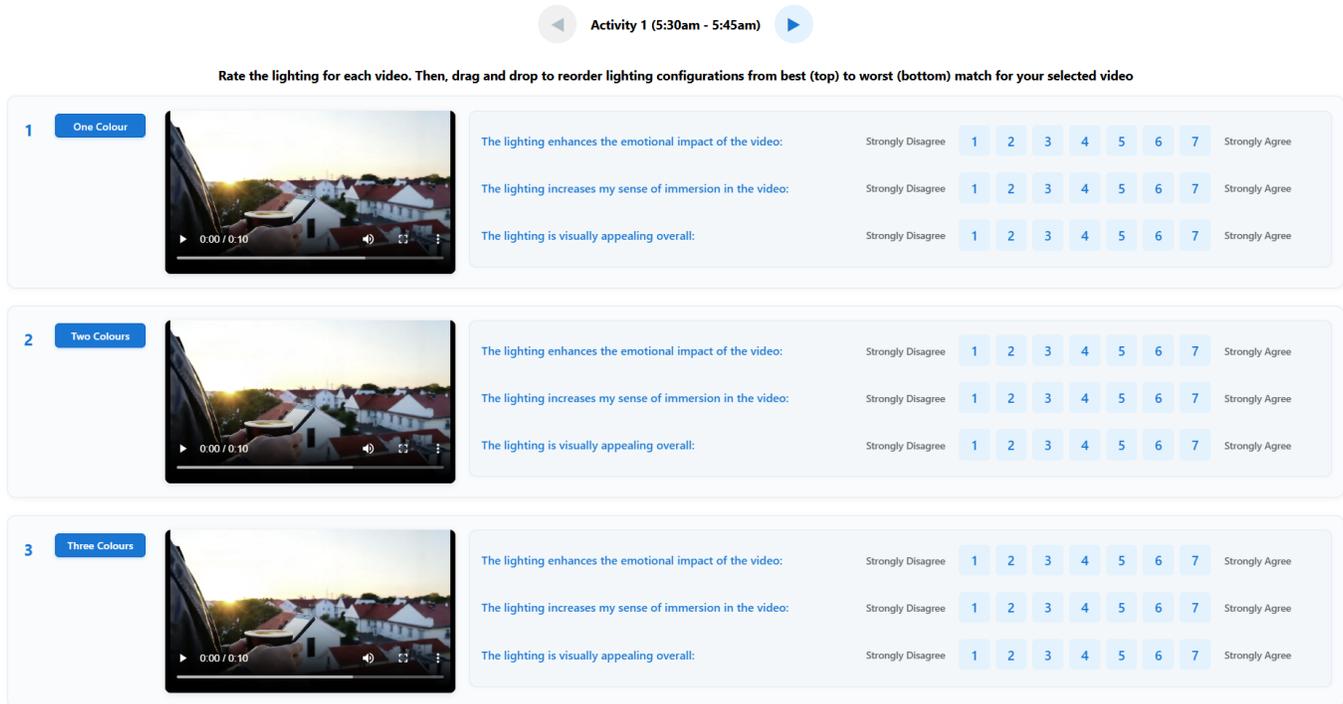


Figure 5: Browser-based evaluation interface used for assessing lighting effectiveness.