Episode-Based Highlighting of Transitional Spaces in Gaussian Splatting for Indoor Wayfinding

Adibah Nurul Yunisya [1], Sisi Zlatanova [2], Edward Verbree [1], Peter van Oosterom [1]

[1] Department of Architectural Engineering and Technology, Delft University of Technology, Julianalaan 134, 2628 BZ, Delft, the Netherlands – (a.n.yunisya, E.Verbree, P.J.M.vanOosterom)@tudelft.nl

[2] School of Built Environment, University of New South Wales, Sydney, NSW 2052, Australia - s.zlatanova@unsw.edu.au

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Abstract

Indoor wayfinding involves not only movement through a spatial transition but also anticipation before the transition and confirmation after it. However, these route-relative phases are rarely represented explicitly in photorealistic three-dimensional environments. This study proposes an episode-based highlighting approach for visualising Transitional Spaces in a Gaussian Splatting scene. A selected route in the West Hallway of the Faculty of Architecture and the Built Environment at Delft University of Technology was organised into Anticipation, Transition, and Confirmation episodes around an L-shaped intersection identified as the Transitional Space core. A separate green–orange–red sequence was used to represent conceptually inferred changes in wayfinding activity and demand, distinguishing episode position from demand interpretation. The environment was captured using PortalCam and reconstructed in LCC Studio. Route-relative regions were then manually segmented and assigned episode and demand classes in SuperSplat before being exported as separate layers. The original Gaussian Splatting scene and highlighted regions were composed at runtime in a Three.js/WebGL viewer. The results demonstrate a gradual route sequence from relatively stable corridor following, through increasing anticipation, to concentrated transition-related activity and subsequent route checking. The approach preserves the photorealistic context of the original scene while making route-related spatial interpretation visually explicit from overview, oblique, and pedestrian-level viewpoints. The proposed method provides a conceptual and visual basis for examining Transitional Spaces in Gaussian Splatting environments. Future work should automate Transitional Space detection and route-relative episode assignment using geometric, semantic, and topological building information and evaluate the resulting classifications through behavioural studies.

1. Introduction

Indoor wayfinding involves interpreting environmental information, forming and updating spatial representations, making route decisions, and translating those decisions into movement towards a destination, particularly in unfamiliar environments (Chen & Stanney, 1999; Passini, 1981). These activities may continue throughout a journey, but their relevance and relative demand may vary between different parts of a route. Weisman (1981) identified four environmental variables that may influence indoor wayfinding: visual access, architectural differentiation, signage and room numbers, and floor-plan configuration. These variables may not affect all spatial conditions in the same way. Along an extended corridor segment, geometry, enclosure, and movement direction may remain relatively consistent, allowing the route ahead to be interpreted through spatial continuity and visible depth. As an intersection is approached, however, the wayfinder may need to identify alternative continuations, interpret local environmental cues, and prepare for a change in movement direction. This suggests that wayfinding activity is not evenly distributed along an indoor route but may change where spatial configuration, visibility, or available movement directions become more complex. De Cock et al. (2022), for example, showed that building configuration interacts with the route information encountered at indoor decision points, indicating that the interpretation of these locations depends on both spatial and informational conditions.

Such route-related variation is particularly relevant where movement crosses an interface between spatial domains. In this study, a spatial domain refers to a locally coherent part of a route characterised by relatively consistent geometry, enclosure, accessibility, level, or movement orientation. A change between spatial domains occurs when one or more of these characteristics changes sufficiently to influence how the following route segment is perceived, interpreted, or traversed. Previous studies have addressed comparable conditions through the concept of Transitional Space. Kray et al. (2013) described Transitional Spaces as in-between spaces situated between distinct spatial domains, particularly in relation to indoor and outdoor environments. Research on seamless navigation has similarly treated entrances, thresholds, and connecting spaces as interfaces between spatial domains and navigation representations (Yan et al., 2019). Within buildings, intersections, entrances, stairs, and other changes in spatial configuration have also been identified as locations where orientation, visibility, route selection, and environmental information become particularly relevant to wayfinding (Hölscher et al., 2006; Jamshidi et al., 2020).

Therefore, a Transitional Space is defined as a route-related spatial configuration situated around the interface between spatial domains, where a change in geometry, enclosure, accessibility, level, or movement direction may require the wayfinder to reinterpret the surrounding configuration, update orientation, or identify an appropriate route continuation. This definition recognises transitionality as both a spatial and route-relative condition. A location may constitute a spatial transition because of its physical configuration, while its wayfinding relevance also depends on the direction from which it is approached and the route through which it is traversed. The same physical intersection may therefore be interpreted differently when approached from another direction or when the selected route follows a different continuation.

The wayfinding relevance of a Transitional Space is not necessarily confined to its geometric centre or physical boundary. Research on pedestrian decision-making indicates that information seeking and directional preparation may begin before a wayfinder enters an intersection (Brunyé et al., 2018). After the spatial or directional change has been traversed, route monitoring and environmental information may also support checking whether the selected continuation remains consistent with the intended route (Alinaghi & Giannopoulos, 2024; Yesiltepe et al., 2021). These findings suggest that wayfinding around a Transitional Space can be understood as a route-relative sequence extending from the approach to the transition, through the encounter with the spatial change, and into the following route segment. The operational episode categories used to represent this sequence are introduced in the Methodology section.

The route-relative episode sequence and the expected wayfinding demand are treated as related but distinct analytical dimensions. The episode sequence describes the position of a route segment relative to a Transitional Space, whereas the expected demand concerns the character and relative concentration of wayfinding activity that may become relevant within that segment. Consequently, one episode may contain more than one demand condition, and similar wayfinding processes may recur across multiple episodes. For example, while approaching an intersection through a long corridor, the wayfinder may initially continue along a clear route with relatively limited interpretative demand. As the intersection becomes perceptually relevant, the same approach episode may involve increased information seeking, anticipatory orientation, and interpretation of possible route alternatives. The episode and demand categories are therefore not assumed to correspond on a one-to-one basis.

The spatial arrangement of the route-relative sequence also depends on the separation between consecutive Transitional Spaces. When two Transitional Spaces are separated by an extended corridor or route segment, the region associated with interpreting the previous transition and the region associated with approaching the following transition may remain spatially distinguishable. Part of the intervening route may consequently remain outside the explicitly highlighted transition-related regions. By contrast, when consecutive Transitional Spaces are connected by a short route segment, the supporting regions associated with the two transitions may spatially overlap. In such a configuration, the route may not provide a clearly distinguishable interval between checking the previous continuation and beginning to interpret the following spatial change. This represents a conceptual spatial overlap between route-relative regions and does not establish that the corresponding cognitive processes necessarily occur simultaneously.

Representing these relationships requires a medium that preserves both spatial configuration and the environmental information encountered from the direction of travel. Three-dimensional digital environments have increasingly been used in indoor wayfinding research because they allow unfamiliar spatial conditions and controlled routes to be repeatedly inspected or experienced (Feng et al., 2022). Conventionally modelled three-dimensional environments, however, may simplify perceptual characteristics of actual indoor spaces, including lighting, surface texture, material differentiation, written information, and local environmental cues. Such simplification may influence how spatial information is recognised and interpreted within a digital environment (Jamshidi, Ensafi and Pati, 2020). This consideration is particularly relevant around Transitional Spaces, where route continuation, alternative directions, boundaries, signage, and landmarks may contribute to interpreting an approaching spatial change.

Within this context, Gaussian Splatting offers a capture-based approach for representing indoor environments with a high degree of visual continuity. Gaussian Splatting encodes a scene through spatially arranged three-dimensional Gaussian primitives, supporting high-fidelity rendering and continuous viewpoint movement without requiring a conventional mesh-based reconstruction workflow (Kerbl et al., 2023). Recent studies have examined its rendering performance, reconstruction quality, robustness, and integration with other spatial-data processes(Lei et al., 2025; Yu et al., 2025). These characteristics make Gaussian Splatting relevant for inspecting indoor environments from both overview and pedestrian-level perspectives while retaining much of the captured visual and spatial context.

A previous feasibility study using the same Gaussian Splatting environment at TU Delft indicated that the corridor was sufficiently represented at the global level, particularly in terms of lighting continuity, colour impression, and spatial proportion (Yunisya et al., 2026). This provides a basis for using the reconstructed environment as the visual setting for the present study. Nevertheless, the reconstruction presents the captured environment continuously and does not inherently assign route-related analytical meaning to the spatial regions surrounding a Transitional Space.

The methodological issue addressed in this paper is therefore the absence of an explicit route-relative interpretation layer within the reconstructed scene. A Gaussian Splatting environment does not inherently indicate where an approaching domain change begins to influence wayfinding, where the transition is encountered, or where the selected continuation may subsequently be assessed. It also does not communicate how the expected character and relative concentration of wayfinding activity may change along these route regions. An additional highlighting layer can complement the photorealistic reconstruction by making the route-relative episode sequence and its associated demand conditions visually explicit without replacing, modifying, or retraining the original scene.

Against this background, this concept paper proposes an episode-based highlighting approach and demonstrates the concept using an existing Gaussian Splatting environment of the West Hallway at the Faculty of Architecture and the Built Environment, TU Delft. The selected route comprises an extended corridor segment followed by an L-shaped intersection. The corridor provides a relatively continuous route field leading towards the intersection, while the intersection forms a Transitional Space core where the route moves between corridor domains with different movement orientations. The demonstration examines how the route can be organised into regions associated with approaching, traversing, and leaving the Transitional Space, and how conceptually inferred changes in wayfinding activity and relative demand can be represented across and within these regions. The resulting annotation layer is visualised in a web-based Three.js viewer and inspected from overview and pedestrian-level perspectives.

The colour coding represents conceptually inferred differences in wayfinding activity and relative demand rather than empirically measured cognitive-load values. The colours are therefore related to, but not in a one-to-one correspondence with, the route-relative episode categories. A relatively continuous section of the approach may, for example, retain the same demand category as a route segment following the transition, despite belonging to a different episode. Conversely, a single episode may change colour when the character of the anticipated wayfinding activity changes.

The contribution of the study lies in demonstrating a route-relative highlighting concept that connects spatial-domain change, wayfinding episodes, and conceptually inferred variations in wayfinding activity within a photorealistic Gaussian Splatting environment. The approach distinguishes the spatial position of the wayfinder relative to a Transitional Space from the expected demand associated with continued route following, anticipatory interpretation, traversing a domain change, and checking the selected continuation. The West Hallway case demonstrates how these related but distinct dimensions can be delineated and visually inspected while preserving the original reconstructed scene. The demonstration is conceptual and does not constitute behavioural validation or direct measurement of cognitive load

2. Methodology

2.1 Research design and demonstration case

This study adopts a concept-demonstration approach to develop and illustrate an episode-based highlighting method for Transitional Spaces within a Gaussian Splatting environment. The method translates literature-informed relationships between spatial-domain change, route context, wayfinding episodes, and expected wayfinding demand into a spatially explicit visual representation.

The method comprises three main stages. First, the relationship between the spatial configuration, selected route, Transitional Space, and route-relative wayfinding episodes is operationalised. Second, the corresponding spatial regions are manually segmented and assigned semantic episode and demand classes within the Gaussian Splatting scene. Third, the original scene and the exported semantic region layers are presented together in a web-based three-dimensional viewer. The demonstration uses a selected route in the West Hallway of the Faculty of Architecture and the Built Environment at Delft University of Technology. The route contains an extended corridor leading towards an L-shaped intersection and continuing along a corridor after the turn. The intersection is treated as the Transitional Space core because the selected route moves between corridor domains with different movement orientations. The route and direction of travel are fixed throughout the demonstration because the relevance and sequence of the highlighted regions depend on how the spatial change is approached and traversed.

2.2 Conceptual relationship between spatial configuration, route context, and wayfinding

The study environment was captured using PortalCam along the West Hallway circulation area. The captured data were reconstructed in LCC Studio to produce the Gaussian Splatting base scene. Gaussian Splatting represents the captured environment through spatially arranged anisotropic Gaussian primitives and enables high-fidelity, real-time visualisation without requiring a conventional polygonal mesh reconstruction (Kerbl et al., 2023).

The acquisition covered the extended corridor, the L-shaped intersection, and the outgoing corridor required for the selected demonstration route. The capture was conducted using PortalCam from XGRIDS. The reconstruction produced a .ply scene containing approximately 979.957 splats. LCC Studio was used for reconstruction, while SuperSplat was used for subsequent inspection, cleaning, manual segmentation, and region export.

The reconstructed scene was retained as an unchanged base layer throughout the annotation and web-visualisation process. The episode and demand representations were produced as additional region layers rather than being permanently embedded into or geometrically merged with the original scene. This separation enabled the original and annotated representations to be viewed independently or simultaneously.

The selected direction of travel was fixed before the spatial classification was undertaken. Fixing the direction was necessary because the relevance and order of the approach, transition, and continuation regions depend on how the intersection is encountered. The same intersection approached from another direction may produce a different incoming segment, outgoing segment, and anticipated movement action.

The Transitional Space core is identified at the interface between locally coherent spatial domains. The selected route and direction of travel determine how the surrounding route field, Anticipation Episode, Transition Episode, and Confirmation Episode are spatially arranged. The episode categories describe the route-relative position around the Transitional Space, while the green–orange–red sequence represents conceptually inferred changes in wayfinding activity and demand. The listed processes are literature-informed associations and are not directly measured cognitive states or cognitive-load values.

As illustrated in Figure 1, the episode classification and demand interpretation form related but distinct analytical dimensions. The episode categories describe where a region is situated relative to the Transitional Space. The demand categories describe how the character and relative concentration of expected wayfinding activity may vary within and across those regions. Consequently, a single episode may contain more than one demand category. For example, the Anticipation Episode may begin while corridor following remains relatively stable and may shift towards increased information interpretation as the intersection becomes more immediately relevant.

2.3 Operational episode and demand classification

Three operational episode categories are used in the demonstration: Anticipation, Transition, and Confirmation. These categories do not replace broader wayfinding-stage models, such as self-localisation, route planning, monitoring, and goal recognition. Instead, they provide a spatial organising structure specifically for representing how a selected route relates to a Transitional Space and how it may be associated with wayfinding processes (Table 1).

The Anticipation Episode is delineated within the approach to the Transitional Space. It begins where the upcoming change in spatial configuration or movement direction becomes sufficiently relevant to the selected route to support information seeking or directional preparation. Because the perceptual availability of an intersection depends on visibility, geometry, and approach direction, no universal metric distance is used to define the beginning of Anticipation. This treatment is consistent with evidence that information-seeking behaviour can occur before entry into an intersection and that directional

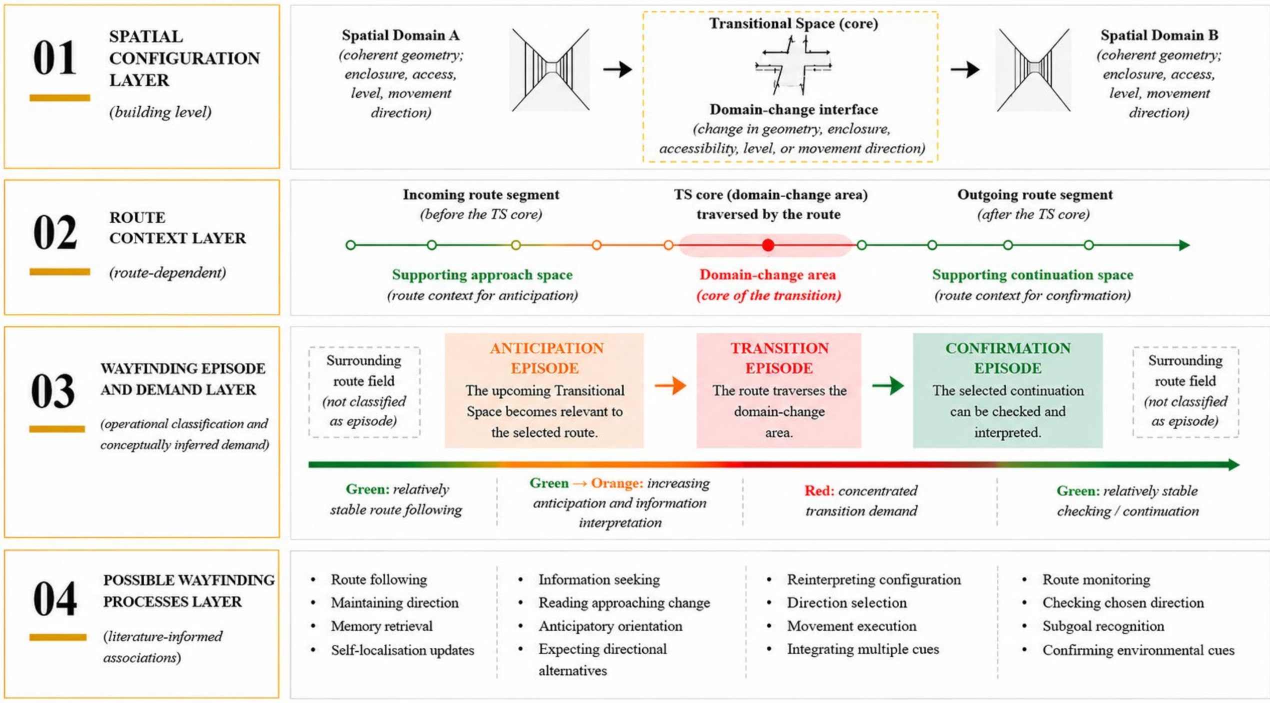

Figure 1. Layered relationship between spatial configuration, route context, route-relative wayfinding episodes, conceptually inferred demand, and possible wayfinding processes.

actions can be anticipated before the turn is physically executed (Alinaghi et al., 2021; Brunyé et al., 2018).

The Transition Episode corresponds to the Transitional Space core. It begins where the selected route enters the domain-change area and ends when the directional turn has been completed and the route becomes aligned with the following corridor. The core is treated as an area rather than as a single point because interpretation, route selection, orientation updating, and movement execution may develop across the junction configuration.

The Confirmation Episode is delineated after the route leaves the Transitional Space core. It represents the spatial opportunity in which the newly selected continuation may be checked against the visible corridor geometry, environmental cues, or landmarks. The region ends when the continuation becomes sufficiently established or when a following Transitional Space begins to become relevant. The use of landmarks and environmental information to determine whether a selected path is correct provides the conceptual basis for this post-transition checking region (Yesiltepe et al., 2021).

The remaining corridor portions are classified as the surrounding route field rather than as an additional episode. General route following, self-localisation, monitoring, and memory retrieval may still occur in these areas, but the regions are not explicitly assigned to the sequence surrounding the demonstrated Transitional Space.

Spatial location	**Episode category**	**Possible associated wayfinding processes**
Continuous corridor route field	No episode assignment	Route following; maintaining direction; general route monitoring; memory retrieval; self-localisation updates
Approach region to the Transitional Space	Anticipation Episode	Information seeking; reading the approaching spatial change; anticipatory orientation; identifying or expecting directional alternatives
Transitional Space core	Transition Episode	Reinterpreting spatial configuration; updating orientation; direction selection; movement execution; integrating multiple environmental cues
Continuation region after the Transitional Space	Confirmation Episode	Route monitoring; checking the selected continuation; subgoal recognition; confirming environmental information

Table 1. Route-relative episode classification across spatial locations

A separate classification is used to represent conceptually inferred changes in wayfinding demand. This distinction is necessary because a route-relative episode does not automatically determine the character or intensity of the expected activity. For example, an individual may already be approaching an intersection while continuing to follow a clear corridor with relatively little need to compare alternatives. As the intersection becomes more relevant, the same Anticipation Episode may involve more active visual search, cue interpretation, and directional preparation.

Research has shown that indoor layout configuration and the information presented at decision points can interact in shaping cognitive load and wayfinding behaviour. Indoor wayfinding literature also identifies floor-plan configuration, visual access, environmental differentiation, landmarks, signs, and maps as factors affecting information pick-up, orientation, and decision-making (De Cock et al., 2022; Jamshidi et al., 2020).

Colour category	Conceptually inferred wayfinding demand
Green	Relatively stable route-following, checking, or continuation demand
Orange	Increasing anticipatory and information-interpretation demand
Red	Concentrated transition-related interpretation and action demand

Table 2. Colour categories and conceptually inferred wayfinding demand

As described in Table 2, Green is used where route continuation is comparatively clear, including continuous corridor following, the early part of an approach, or checking and following the selected continuation after the transition. Orange is used where the approaching spatial change becomes more immediately relevant, and additional information may need to be collected or interpreted. Red is used around the demonstrated Transitional Space core, where reinterpretation of the configuration, directional action, and movement execution are conceptually concentrated.

The colour categories are not in a one-to-one relationship with the episode categories. Anticipation may, for example, contain both green and orange conditions. Green may also appear within the surrounding route field and the Confirmation Episode. The colours therefore represent relative differences in expected wayfinding activity, not low, moderate, or high measured cognitive-load values.

2.4 Gaussian Splatting reconstruction and manual semantic segmentation

The West Hallway environment was captured using PortalCam and reconstructed as a Gaussian Splatting scene in LCC Studio. Gaussian Splatting represents a captured scene through spatially arranged anisotropic Gaussian primitives and supports high-quality, free-viewpoint rendering without conventional mesh reconstruction (Kerbl et al., 2023). The resulting reconstructed scene was used as the visual base for the demonstration. It was subsequently opened in SuperSplat for scene inspection and manual semantic segmentation. In this study, manual semantic segmentation refers to the selection and separation of Gaussian splats according to the route-relative spatial classes defined in Section 2.3. It does not refer to automated object recognition or machine-learning-based semantic segmentation.

The segmentation process commenced by examining the reconstructed scene from overview, oblique, and pedestrian-level perspectives. The selected route and direction of travel were then used to locate the continuous corridor field, approach region, Transitional Space core, and continuation region. Their boundaries were manually delineated according to the episode logic described above.

Each selected region was subsequently assigned two types of semantic information:

1. its episode classification, consisting of no episode assignment, Anticipation, Transition, or Confirmation; and
2. its conceptually inferred demand category, represented by green, orange, or red.

The corresponding splats were recoloured and exported per area as separate region layers. The original Gaussian Splatting scene was retained as an independent base scene rather than permanently modified or geometrically merged with the exported regions. This separation enables each semantic area to be displayed independently and allows the original visual context to remain available in the web demonstration. Figure 2 summarises the reconstruction, semantic-segmentation, and web-visualisation workflow.

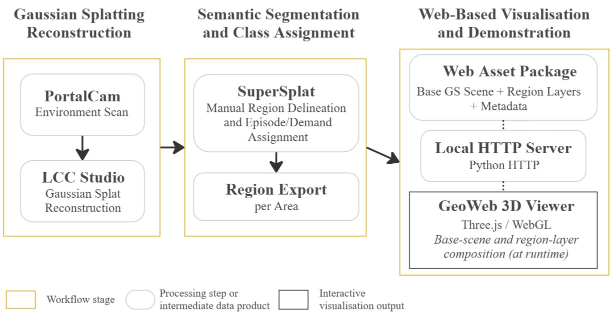

Figure 2. Gaussian Splatting reconstruction, manual semantic segmentation, and web-based visualisation and demonstration workflow.

The West Hallway environment is captured using PortalCam and reconstructed as a Gaussian Splatting scene in LCC Studio. The reconstructed scene is manually segmented in SuperSplat, where route-relative regions are delineated and assigned episode and demand classes before being exported per area. The original base scene, exported region layers, and associated metadata are organised as a web asset package and delivered through a local HTTP server to the web-based Three.js/WebGL viewer.

2.5 Web-based visualisation and demonstration

The web-based demonstration was structured around three types of assets: the original Gaussian Splatting base scene, the separately exported semantic region layers, and metadata describing the corresponding episode, demand category, sequence, and spatial interpretation. These resources were organised as a web asset package. The package was delivered through a local Python HTTP server and loaded into a three-dimensional viewer developed using Three.js and WebGL. The original base scene and the semantic regions remain separate resources and are composed only when the viewer is running. The process is therefore described as runtime layer composition rather than as a geometric merge.

The demonstration provides an original-scene view in which the unmodified Gaussian Splatting environment can be examined without highlighting. It also provides a semantic-layer view that displays the segmented route regions independently, as well as a combined view in which the coloured regions are presented together with the original scene.

The interface includes controls for displaying or hiding individual semantic regions, adjusting overlay opacity, and resetting the camera. Predetermined viewpoints provide an overview of the route-wide distribution, an oblique view of the corridor and intersection configuration, and pedestrian-level views corresponding to the approach, Transitional Space core, and continuation after the turn. These views allow the relationship between the environmental context, episode classification, and conceptually inferred demand to be examined at both route and pedestrian scales.

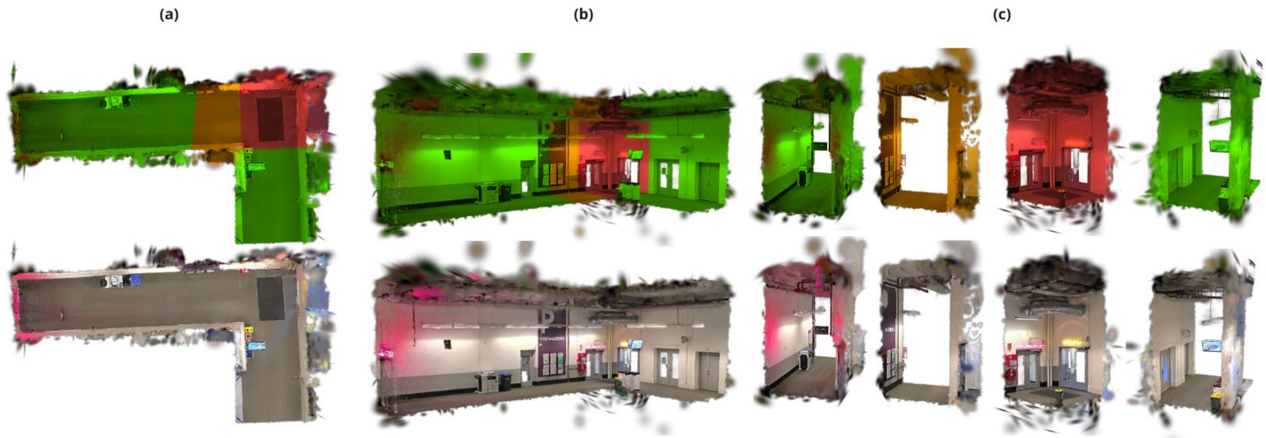

Figure 3. Route-relative episode and wayfinding-demand highlighting in the West Hallway Gaussian Splatting environment. (a) Top views, (b) oblique views, and (c) pedestrian-level views of the approach, transition, and continuation regions. The upper row shows the highlighted scene, while the lower row shows the corresponding original scene. Green, orange, and red represent conceptually inferred wayfinding demand rather than measured cognitive-load values.

The demonstration is intended to show that route-relative wayfinding information can be made visually explicit while preserving the photorealistic environmental context of the Gaussian Splatting scene. It is not presented as a completed navigation application or as evidence that the highlighted classifications have been behaviourally validated.

3. Results and Discussion

3.1 Gaussian Splatting environment and semantic region delineation

The reconstruction produced a continuous Gaussian Splatting representation of the selected West Hallway route, including the extended corridor, the L-shaped intersection, and the corridor segment continuing after the turn. At the overall spatial scale, the reconstructed scene preserved the principal corridor geometry, enclosure, movement axes, and environmental appearance required to distinguish the approach, intersection, and continuation of the selected route.

The original GS environment did not contain an explicit indication of where the approaching spatial change became relevant, where the domain change was traversed, or where the selected continuation could subsequently be checked. These route-related conditions became explicit only after the corresponding Gaussian splats had been manually delineated and assigned episode and demand classes in SuperSplat. Figure 3 presents the resulting GS scene from three complementary viewing scales. The top-view comparison shows the overall distribution of the highlighted regions along the route. The oblique view clarifies how the regions correspond to the three-dimensional corridor and intersection configuration. The pedestrian-level views show how the same highlighted areas appear from positions closer to those encountered while moving along the selected route.

The comparison between the highlighted and original views indicates that the semantic regions can be added without removing the visual context of the reconstructed environment. The original scene continues to provide architectural and environmental information, while the additional layers make the route-relative interpretation visible. The method therefore does not replace the photorealistic GS representation but adds an analytical layer through which the route can be inspected in relation to the Transitional Space.

The top view is useful for reading the full spatial sequence, but it does not by itself show what environmental information would be available from the direction of travel. The oblique and pedestrian-level views address this limitation by presenting the regions in relation to corridor depth, enclosure, openings, and the changing movement axis. This is particularly relevant at the L-shaped intersection, where the spatial transition is experienced through a change in orientation rather than only through a change in plan position.

3.2 Route-relative episode and demand sequence

The resulting highlighting is organised around one selected direction of travel. It begins within the extended corridor, continues through the L-shaped intersection, and ends within the corridor reached after the turn. The extended corridor and intersection are not treated as separate episode types. Instead, they provide the spatial setting within which the episode and demand categories are arranged. Along the initial corridor extent, the route remains comparatively continuous and is represented in green. This condition corresponds to relatively stable route following, where the movement axis and corridor continuation remain readable. Part of this region remains outside the explicitly assigned episode sequence as surrounding route field.

As the L-shaped intersection becomes increasingly relevant to the selected route, the corridor enters the Anticipation Episode. The beginning of Anticipation does not immediately require a change from green to orange. The early part of the approach may remain green while the user continues to follow the corridor. The highlighting changes towards orange nearer the intersection, where interpretation of the approaching geometry, preparation for a directional change, and the possible search for relevant information become more prominent. The result therefore shows that the Anticipation Episode can contain more than one conceptually inferred demand condition. At the beginning of the approach, route following may remain relatively stable, while anticipation and information interpretation gradually increase as the intersection becomes more immediately relevant. This distinction prevents the entire Anticipation Episode from being interpreted as uniformly demanding.

The L-shaped intersection is represented as the Transitional Space core and assigned to the Transition Episode. The region is highlighted in red because the selected route changes movement orientation within this area. The highlighting indicates a conceptual concentration of spatial reinterpretation, directional action, and movement execution. However, it does not establish that all users experience their highest cognitive load at the same position, nor does it identify the exact location of an individual decision.

After completing the directional turn, the route enters the Confirmation Episode. This region is represented in green to indicate that the selected continuation becomes available for checking and continued movement. Green therefore occurs both before and after the red transition region, but with different route-relative meanings. Before the transition, it represents relatively stable corridor following, whereas after the transition, it represents checking and continuing along the selected route.
Overall, the demonstrated sequence progresses from the surrounding route field into an Anticipation Episode characterised by a gradual change from green to orange, followed by the red Transition core and a green Confirmation and continuation region.

The results support the methodological distinction between the two classifications. Episode categories describe the position of a region relative to the Transitional Space, whereas the colour sequence describes the conceptually inferred character of wayfinding activity. They are related but do not form a fixed one-to-one correspondence.

3.3 GeoWeb 3D Viewer

The original GS scene and exported semantic regions were subsequently loaded into the GeoWeb 3D Viewer. The viewer was implemented using Three.js and WebGL and delivered through a local Python HTTP server. The base scene and semantic regions remain separate web assets and are composed when the viewer is running rather than being permanently merged into a single GS file. Figure 4 presents the interface used in the earlier implementation. The viewer includes controls for displaying the original GS environment and semantic region layers, adjusting the opacity of the highlighting, and selecting individual areas for closer inspection. These functions allow the viewer to alternate between environmental context and analytical emphasis.

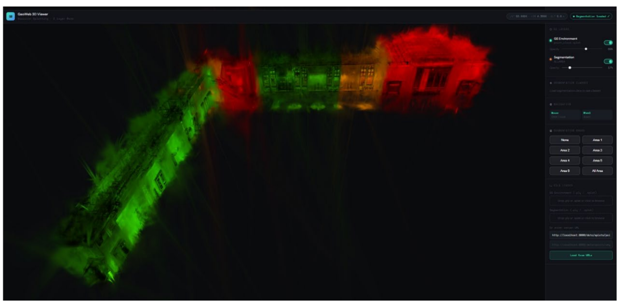

Figure 4. GeoWeb 3D Viewer showing the Gaussian Splatting base scene and semantic region layers.

The upper view presents the region layers at partial opacity, allowing the original GS appearance to remain visible beneath the highlighting. The lower view presents the semantic regions with stronger visual emphasis. The interface panel provides layer visibility controls, an opacity adjustment, and area-selection controls for isolating individual regions. The original scene and exported region layers are composed at runtime in the Three.js/WebGL viewer and remain separate assets.

At partial opacity, the underlying corridor appearance remains visible beneath the semantic regions. This mode supports interpretation of the highlighting in relation to architectural elements, surfaces, signs, and corridor geometry. At greater opacity, the semantic structure becomes more visually dominant and the distribution of green, orange, and red regions can be inspected without competing scene detail. The independent layer controls also allow the original scene to be displayed without highlighting. This provides a direct comparison between the unmodified reconstruction and the analytically enriched representation. Individual region selection further enables the extended corridor, approach, Transitional Space core, and continuation to be inspected separately. The viewer therefore performs two related functions. First, it presents the route-relative classification within the photorealistic environment. Second, it supports inspection of how the classification changes when the original scene, semantic layers, or selected regions are displayed with different visual emphasis.

4. Conclusion, Limitations, and Recommendations

4.1 Conclusion

This study proposed an episode-based highlighting approach for representing route-relative conditions around a Transitional Space within a Gaussian Splatting environment. The selected West Hallway route was organised into Anticipation, Transition, and Confirmation episodes, while a separate green–orange–red sequence represented conceptually inferred changes in wayfinding demand. This distinction showed that episode position and expected demand are related but not equivalent. The corresponding regions were manually segmented in SuperSplat and exported as separate layers. The original Gaussian Splatting scene and the highlighted regions were then composed at runtime in a Three.js/WebGL viewer. The demonstration showed that route-related wayfinding information can be made visually explicit while preserving the original photorealistic environment.

4.2 Limitations and Recommendations

The episode boundaries and demand categories were manually delineated and were not validated using behavioural, eye-tracking, physiological, or cognitive-load measurements. The demonstration was also limited to one route, one direction of travel, and one L-shaped intersection. Consequently, the results illustrate the proposed concept but do not establish universal episode boundaries or user responses. The segmentation was not derived from a registered building model or navigation network, and the web viewer was developed only as a visual demonstrator. Limitations in the Gaussian Splatting reconstruction, particularly incomplete splats and reduced fine-detail legibility, may also affect interpretation from some viewpoints.

Future work should prioritise the automated detection and delineation of Transitional Spaces using geometric, semantic, and topological information from Building Information Modelling or indoor navigation models. The detected Transitional Space cores could then be combined with a selected route and direction of travel to computationally assign the Anticipation, Transition, and Confirmation regions and transfer them into the Gaussian Splatting environment. The resulting automated workflow should subsequently be evaluated using participant behaviour, gaze, pauses, movement speed, and reorientation patterns across different routes and spatial configurations.

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Data Availability

The datasets for this research can be accessed at https://doi.org/10.4121/a74f12ce-bb11-462c-bbaf-c9bd3cd4c2b6.

Declaration of Generative Ai Use

During the preparation of this work, the author(s) used ChatGPT (OpenAI) solely for language editing, including improving grammar, clarity, and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

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