

Article

Embodied Sensory Experience and Spatial Mapping in Damascene Courtyard Domestic Architecture

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Abstract

Sensory mapping in architecture lacks a guiding theoretical model, leaving practitioners without a clear way to relate spatial design to embodied experience. This study introduces a structured methodology that links phenomenological observation with affordance theory and sensory semiotics, framing sensory data within architectural contexts. Fieldwork in fourteen courtyard houses of Damascus had residents trace their movements on simplified floor plans, switching colors as sight, sound, touch, smell and taste became dominant. The analysis reveals that visitors pass through a narrow entry corridor, enter the courtyard, and converge at the central fountain, which emerges as a focal point for multiple senses. Residents consistently trace tactile interactions along the fountain's stone rim and at raised benches in the liwan (open space). Gustatory (taste-related, food-linked) markers appear along the route from kitchen thresholds toward the fountain, suggesting how food preparation and communal gathering overlap. Using 28 sensory maps and a three-level analytical process, comparison, synthesis, and spatial interpretation, the study produced a unified sensory map of the Damascene courtyard house. This pattern highlights how sequential spatial arrangements shape sensory engagement and suggests conservation strategies that preserve these experiential pathways. Architects and conservators can reinforce welcome gestures at thresholds and design water features and planting schemes that invite lingering. The proposed methodology fills the theoretical gap and offers clear guidelines for crafting spaces that respond to human perception.

Keywords: sensory mapping; Damascene courtyard; architecture; liwan (open space)

1. Introduction

Courtyard houses stand among the earliest domestic forms in human history, with evidence of inward-facing dwellings appearing more than five millennia ago in regions as diverse as Mesopotamia and the Indus Valley [1]. Scholars often treat these structures as climatic solutions, focusing on temperature regulation and daylight control, yet the role of human senses in shaping movement and memory within their walls has received far less attention [2]. Simple sightlines and spatial hierarchies tell only part of the story; the sound of trickling water, scent of jasmine, feel of carved stone and taste of courtyard-grown citrus also guide one's path. Damascus offers a rare living archive of courtyard houses whose origins reach into the third millennium BCE [3]. Within the walled historic core, recognized through UNESCO inscription of the Ancient City of Damascus as World Heritage



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in 1979 [4], courtyard houses remain occupied by families whose daily routines embed sensory cues in surfaces, edges, and microclimatic transitions. Rather than treating these houses only as climatic devices or stylistic artifacts, this study foregrounds how threshold sequences, water, planting, and seating invite attention, movement, and recall through multi-sensory experience. Classic elements define these homes: a narrow entrance passage that muffles street noise and subtly cools incoming air; a central courtyard paved in marble or basalt that catches shifting sunlight; a *liwan* (open space), or open hall, where gentle breezes meet shaded walls; and one or more fountains carved from local limestone or inlaid marble [5]. Plants cluster at courtyard edges, mixing ornamental roses, jasmine and Sambac jasmine with fruit-bearing trees such as orange and pomegranate [6]. Even small variations in courtyard size or fountain design shape patterns of heat gain and air-flow, yet those factors serve also as carriers of smell and sound. A great deal of research has chronicled these houses from single-discipline angles. Studies of religious iconography and room arrangement trace shifts from Umayyad through Ottoman rule [7–9]. Environmental analyses chart courtyard microclimates and seasonal comfort [10,11]. Technical treatises focus on masonry, timber framing and water management [12–14]. Aesthetic inquiries highlight marble motifs and wood-carved *mashrabiya*s [1,15]. Social studies map household organization and guest rituals [3,16], while economic and sustainable perspectives assess living patterns and resource use [8,17]. That wealth of detail has shaped our sense of form and function, though it leaves out the sensory choreography that unfolds as light, sound, texture and aroma converge around thresholds, fountains and *liwan* (open space)s. Pioneering investigations in sensory mapping offer methods for tracing smell-walks and soundscapes in urban settings. Scratch-and-sniff installations have drawn attention to smell biases in public space [18]. Digital mash-ups have charted wafting aromas of chocolate and coffee across city blocks [19–21]. Tonotopic and isomap techniques capture birdcalls or traffic hum in thermal-camera-style overlays [22,23]. Rising interest in haptic mapping for accessibility yields raised reliefs and 3D-printed models for blind users [24]. Visual sensory maps, long used by planners to chart pollution or pedestrian flows, add color-coded layers of environmental data [25,26]. Those approaches accommodate one or two senses at a time but rarely account for how taste, touch, smell, sound and sight intersect in a single architectural typology. A unified sensory map would track moment-to-moment shifts: the click of sandals on marble, the whisper of wind down a narrow corridor, the burst of citrus scent at kitchen thresholds, the cool wet arc of fountain mist on a wrist. Uncovering those shifts calls for a theoretical frame that acknowledges body, object and environment in dynamic relation. Phenomenological accounts position architecture as lived experience, where perception and movement shape one another [27]. Affordance theory describes surfaces and openings as invitations or deterrents to action. Spatial semiotics treats material signs, light patterns, water sound, textured stone, as carriers of meaning. Combining those lenses offers a way to interpret participant-generated sensory tracings. This study aims to map sensory activations across fourteen Damascene courtyard houses, identifying which architectural elements engage particular senses and how these activations unfold through thresholds, courtyards, fountains, and *liwan* (open space)s. The study interprets participant-generated sensory traces through three complementary lenses, phenomenological accounts of lived experience, affordance theory, and sensory semiotics, to clarify how spatial sequences shape embodied attention, movement, and recall. The specific focus is captured in three research questions: how do residents' sensory emphases shift along the entrance–courtyard–fountain–*liwan* (open space) sequence; which architectural elements act as repeated multi-sensory anchors across cases; and how can the resulting sensory patterns be translated into conservation and design strategies that preserve experiential pathways? Procedural details of participant mapping, coding, digiti-

zation, and cross-case synthesis are described in the methodological framework. The article is structured as follows: Section 2 surveys previous mapping efforts, organized by sensory domain and noting methodological tendencies and omissions; Section 3 outlines the historical development and spatial logic of Damascene courtyard houses; Section 4 introduces the theoretical foundations, phenomenology, affordance theory, and semiotics, and shows how these approaches support the reading of sensory sequences; Section 5 presents the findings from each house, noting common trajectories that move from entrance areas to fountains and liwan (open space)s; and Section 6 provides a conclusion that reflects on the study's limitations and suggests directions for further research, including virtual modeling and comparative studies across different cultural settings.

2. Literature Review

Mapping has long been used to describe how sensory experience becomes organized and legible, including in neuroscience through topographic representations (e.g., somatotopic, retinotopic, and tonotopic mappings) that illustrate patterned correspondences between sensory input and perceived structure [28–30]. In this study, these neural concepts are treated as a conceptual analogy for structured representation rather than as the analytical basis for architectural interpretation. The methodological foundation for the present study comes instead from built-environment and qualitative traditions that document experience in situ, especially sensory ethnography and go-along/walk-along approaches that capture perception while moving through real settings [31,32]. This positioning clarifies why participant-generated traces, combined with a transparent synthesis workflow, are appropriate for understanding how multiple sensory emphases unfold across a specific architectural typology. Urban smell investigations commenced with tangible scent samples. Scratch-and-sniff installations revealed residents' odor preferences in the work of Davis and Thys-Şenocak [18]. Sissel Tolaas conducted over fifty exhibitions pairing electronic-nose measurements with synthetic fragrance panels, and Nicola Twilley mapped New Yorkers' genetic odor predispositions using personalized scratch patches. McLean's 2012 chocolate-aroma mash-up gathered experiential reports on Tumblr and Reddit [19]. In 2019, French design students shaped haptic scent forms from source materials to delineate zones of fragrance overlap [20,21]. Lin-Greenberg [33] documented the influence of dew point and wind speed on donut aromas during eleven days of street-level sampling by Esther Wu, who employed circular symbols to record each scent's persistence. Méndez Vázquez [34] led eleven-day participatory smell-walks that translated live observations into watercolor, animation, and sculpture. Taste mapping treats food itself as a cartographic medium. McLean [20,21] compared regional dishes with urban landmarks on illustrated maps, and artists such as Rosie Mackean designed bespoke food-and-drink guides that highlight local ingredients. Hopkins captured urban temporality through Jell-O city-block sculptures whose progressive decay reveals changes in texture and flavor [35]. Levin and Hargreaves [36] synthesized emblematic foods into edible maps that define zones suited for urban agriculture, fostering dialogue on local food systems. Auditory mapping extends back to mid-twentieth-century conceptions. Finnish geographer Granö first outlined the concept of auditory scape-mapping, and Thulin [37] recorded temporal and frequency attributes of natural and urban sounds to probe memory, culture, and everyday life. Southworth [22] charted Boston's diurnal versus nocturnal sound patterns on visual cartophony diagrams. Truax [23] mapped acoustic pressure variations across diverse environments using digital overlays. Simon Elvin deployed acoustic sensors and triangulation in London to locate gunshots, after which mobile units were dispatched for field verification [20,21]. Tscirhart [38] created a non-digital FM-station map utilizing conductive pushpins and pencil-drawn lines to tune live broadcasts. Ruchlewicz-Dzianach [39] devel-

oped a sound-only map of Gdańsk navigable without visual cues. Eyerly [40] interwove personal reflections into audio tours of Black Hills heritage sites. Touch-based models appear in raised-relief form. Weimer [24] cataloged embossed maps, raised-surface reliefs, and a haptic globe fabricated via vacuum forming, 3D printing, and swell paper for visually impaired users at the Perkins School. Public bronze relief city models installed in parks invite both blind and sighted visitors to explore urban form through touch. Visual cartography remains a cornerstone of urban planning. Guo [25] employed color-coded lines and geometric shapes to depict traffic flows, subway networks, and demographic trends. Md et al. [26] utilized gradient scales to illustrate air pollution hotspots in Beijing and New Delhi. Lynch [41] described how landmarks and pathways shape mental representations of city environments. Although each study offers robust, sense-specific methodologies, scratch-and-sniff sampling, edible media, isobel contours, haptic relief, and color gradients, none track the sequential interplay of taste, touch, smell, sound, and vision within a single architectural typology. The proposed approach synthesizes phenomenology, affordance theory, and semiotics applied to participant tracings in Damascene courtyard houses, capturing multisensory flows through thresholds, courtyards, and liwan (open space)s.

3. Damascene Courtyard Houses

The traditional courtyard house in Damascus, Figure 1, represents a distinctive architectural model prevalent in major Syrian cities such as Damascus, Aleppo, Homs, and Hama. The earliest examples of these houses date back to the Ayyubid period, although the majority belong to the Mamluk and Ottoman periods [42]. The number of courtyards within a house varies according to its size and level of luxury; larger residences may include two or three courtyards, while most traditional homes contain a single courtyard, the dimensions of which typically reflect the economic status of their occupants [5]. Alba-keer [6] and Hatahet [8] identified the key architectural features of the Damascene courtyard house as the entrance, courtyard space, and the liwan (open space). These components were derived from Zakaria's book *Traditional Damascene Houses* [43], which will be further elaborated upon in this section.



Figure 1. Courtyard area in a courtyard house in Damascus [42].

3.1. The Entrance

In order to access the central courtyard, which functions as the primary focal point of the house, a long, narrow passageway is typically used to connect the entrance with the courtyard, thereby enhancing the residents' privacy. A distinct spatial hierarchy is evident in the organization of movement, beginning with the public domain of main streets, progressing through semi-public pathways, and ultimately leading to the private sanctuary of the courtyard area, Figure 2 [8].



Figure 2. Houses' entrances not facing each other alongside the street [6].

3.2. Courtyard Space

The courtyard in traditional Damascene houses represents the central and most prominent space within the dwelling. Architecturally, it acts as a pivotal connector, integrating various rooms and facilitating smooth internal circulation. The dimensions and layout of the courtyard differ according to the house's status, ranging from expansive courtyards embellished with elaborate marble details and fountains to more compact ones incorporating black stone features. Courtyard components contribute to thermal regulation by minimizing solar radiation and dryness. Moreover, the courtyard offers a secluded communal space for families while enabling convenient access to various sections of the house. It establishes a contrast between the understated external appearance and the richly detailed interior, thereby enriching the residential experience in Damascene homes [8]. Vegetation is integral to both the aesthetic and environmental roles of the courtyard. Plant species are divided into ornamental varieties, such as roses, jasmine, Sambac jasmine, and tulips, and fruit-bearing trees, including citrons, oranges, lemons, and pomegranates [6]. A fountain serves as a defining feature of the Damascene courtyard, generally positioned in front of the liwan (open space). These fountains, Figure 3, are crafted in diverse forms, octagonal, pistol-shaped, square, ring, star, curved, and oval. They are commonly constructed from stone or ornamental marble, with external surfaces decorated with inlaid stone and interiors lined with waterproof lime to ensure durability and effective water retention [44].



Figure 3. Various shapes of the fountain in the courtyard space [44].

3.3. The Liwan (Open Space)

The traditional Damascene courtyard house incorporates a prominent architectural element known as the liwan (open space), Figure 4, typically aligned with the courtyard floor level or occasionally slightly elevated [45].



Figure 4. The liwan (open space) of the Al-Azem Palace in Damascus.

In more spacious homes, it is customary to find two liwan (open space)s, Figure 5, each serving a distinct seasonal purpose. The first liwan (open space) is deliberately positioned to face north, providing essential shading for the courtyard during the summer. Its extended depth helps block direct heat radiation reflected from the ground. Furthermore, it functions as a visual shield, reducing glare and enhancing occupant comfort during peak heat hours [8,43].

Conversely, the second liwan (open space) faces south, enabling it to capture sufficient solar radiation during the winter months. Throughout the year, liwan (open space)s serve as multifunctional areas within the courtyard, Figure 6, accommodating a range of

activities such as living, food preparation, dining, seating, recreation, sleeping, family gatherings, and circulation between rooms.

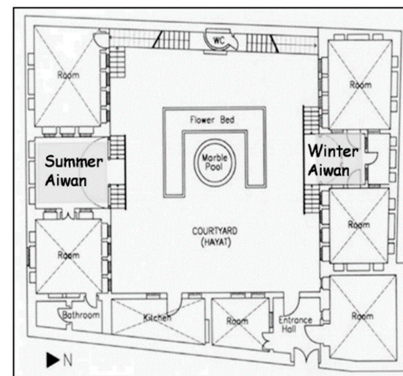


Figure 5. Layout of urban house Damascus with two liwan (open space)s [43].



Figure 6. Elements of the liwan (open space).

The liwan (open space) varies in both height and depth, sometimes extending across two or three levels, and is typically oriented to the north. It is often raised 40 to 50 cm above ground level to promote better ventilation and thermal efficiency. Adjacent halls fitted with glass windows offer supplementary functional spaces [8,43].

4. Methodological Framework

Building on earlier research that introduced sensory mapping, this study shapes a method specifically designed for Damascene courtyard houses. Participants take part by tracing their sensory responses onto simplified schematic floor plans of their own homes. These plans were hand-drawn by the researcher during site visits in a deliberately accessible format, since most participants were not architects and could engage more easily with schematic drawings than technical CAD layouts. Each sense is represented by a different color marker: yellow for hearing, purple for touch, red for taste, green for smell, and blue for sight. Mapping was conducted in situ as a walk-along activity inside the house: as participants moved through key areas such as the entrance, courtyard, fountain, and liwan (open space), they traced their route on the plan and switched markers whenever a different sense became dominant in that moment. The first stage of the study involved selecting two participants from each house. This helped ensure that various sensory viewpoints were represented, which supports more reliable conclusions. Participants were instructed

to begin at the house entrance, then draw their path through the architectural elements, courtyard, fountain, liwan (open space), and other significant areas, changing colors based on the sense that stood out at each location.

To make the mapping process reproducible, the fieldwork followed a consistent and documented workflow. During each site visit, the researcher first produced a simplified schematic plan by direct observation, marking the entrance corridor, courtyard boundaries, fountain location, liwan (open space) position, kitchen threshold, stairs, and the main rooms opening to the courtyard. The plan was intentionally schematic and label-based rather than a fully dimensioned architectural drawing, because it served as a participant-facing template for tracing experience rather than as a construction document. Before the mapping began, the researcher explained the plan to the participant, confirmed orientation and key elements, and ensured the participant could identify the locations they would pass through.

The mapping session itself was conducted as a walk-along activity inside the house rather than a memory-only exercise. After the short orientation, the participant walked through the dwelling starting from the entrance and moving toward the courtyard and its key elements, while drawing the route directly onto the plan. Five colored pens were provided, and the participant switched color whenever the dominant sense changed (yellow hearing, purple touch, red taste, green smell, blue sight). Because “taste” can be misunderstood when discussed in relation to built space, the red traces are interpreted here as gustatory or food-linked moments rather than as literal tasting of architectural materials. Participants were not asked to taste surfaces; they marked red only when the experience of space was dominated by eating- and food-related experience, such as at the kitchen threshold, during serving routines, or during movement toward communal gathering zones where food consumption commonly occurs. This framing aligns with multisensory research emphasizing that gustation is frequently entangled with smell, anticipation, and memory in everyday environments, and that place cues can evoke taste-related experience even when the act of eating is not occurring at that instant.

Each session lasted approximately 45 min to one hour, including the explanation of the plan and the mapping task.

After the site visits, the hand-drawn schematic plans were digitally reconstructed in AutoCAD 2022 to generate consistent base plans for documentation. Participant traces were then manually transferred onto the corresponding AutoCAD-based plan using Microsoft PowerPoint while preserving the same color-coding system and path geometry (Level 1). Level 1 outputs were then overlaid and synthesized to produce the House-Level Sensory Map for each case. In Level 2, House-Level Sensory Maps were grouped by gate district and overlaid using PowerPoint to produce one Gate-Level Sensory Map for each gate district. In Level 3, the final visual synthesis and heat-map style outputs were produced in Adobe Photoshop.

Intensity was defined operationally through overlap frequency, consistent with the layered nature of the analysis. Areas where the same sense was traced repeatedly by different participants and/or across synthesized layers were treated as stronger intensity, while isolated or scattered traces were treated as lower intensity. This definition is applied transparently within the Level 1 to Level 3 synthesis logic described above, so that “strong” indicates repeated, shared traces rather than an assumed physical magnitude.

It should be noted that the limited availability of Damascene courtyard houses with preserved key architectural features constrained the sample size to fourteen cases. The cases were distributed across the Old City to achieve geographic coverage using the established gate-district divisions as a practical spatial stratification tool for location-based organization rather than a symbolic rationale. Selection followed explicit inclusion criteria

tied to the research aim: each case needed a preserved courtyard–house sequence (entrance corridor–courtyard–fountain–liwan (open space)), the presence of the key architectural elements that structure this sequence (courtyard, fountain, and liwan (open space)), ongoing residential use at the time of fieldwork, and resident permission for accompanied in-house walk-along mapping. Practical constraints such as restricted access, ongoing restoration, neglect, and functional conversion also shaped the final set of houses included in the study. The spatial distribution of the fourteen case studies across the Old City is illustrated in Figure 7.

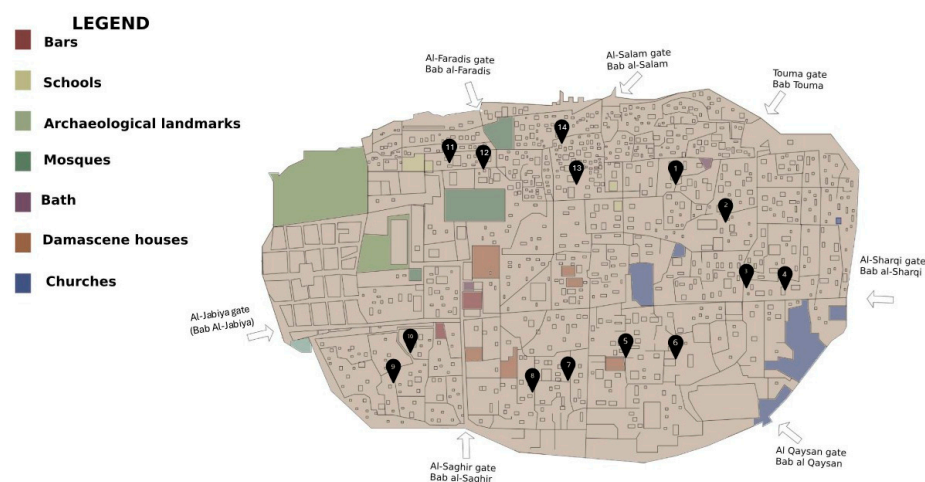


Figure 7. Map of Old Damascus showing the locations of the fourteen selected case studies. The numbered markers (1–14) represent both the locations of the selected case studies within the map of the Old City of Damascus. The arrows represent the locations of the seven historic gates surrounding the Old City.

The study includes a structured comparison of sensory differences among participants. One aim is to determine whether people experience similar sensory reactions in equivalent settings, or if their responses vary according to personal interpretation. Looking at the maps created by different participants makes it possible to identify repeated features or changes in perception, which allows for the construction of a wide-ranging sensory diagram of the Damascene courtyard house. The analysis takes place in two rounds, each serving a specific purpose in understanding how people experience these houses. In addition, all methods in this study were performed in accordance with the relevant guidelines and regulations.

4.1. Level 1—House-Level Synthesis

Prior to analysis, participants engaged in guided sensory mapping sessions using a standardized script provided by the researcher (see Appendices A and B).

Two participant maps are compared within each house to identify convergences and divergences under the same spatial layout. A convergence is recorded when both participants mark the same sensory category within the same tolerance zone around a spatial anchor or segment on the base-map. For point anchors (such as the fountain center), the tolerance zone is defined as a buffer radius proportional to the plan scale; for linear segments (such as the entrance corridor), convergence is defined as overlapping marks along the same segment length. Where participants mark the same sense in the same tolerance zone but draw different path geometries, the sense is treated as shared but lower in geometric consistency, and this distinction is carried forward into Level 2 and Level 3 synthesis. The resulting output is a House-Level Sensory Map that preserves both shared anchors and meaningful within-house variation (see Table 1).

Table 1. Level 1—House-Level Synthesis of sensory maps in Damascene houses. Arabic terms labeled on the plan are defined as follows: “المدخل باب” — Entrance door; “غرفة” — Room; “الليوان” (Liwan—open area); “القاعة” — Main hall; “السطح” — Roof.

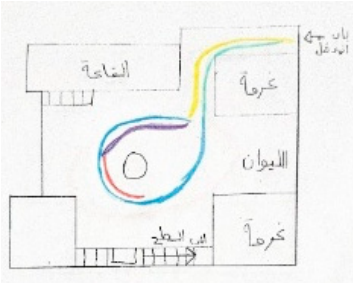
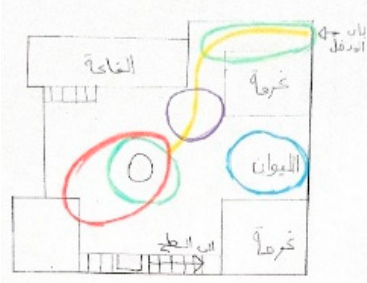
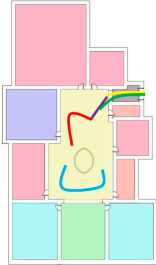
Sensory Mapping of the First Participant	Sensory Mapping of the Second Participant	Final Sensory Map Represents the Gate
Touma Gate (Bab Touma) Case 1		
		LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom 
Participant 1	Participant 2	Summary of Similarities
1. Entrance zone - Auditory (Yellow): tracing the sound of the fountain extending from the courtyard into the corridor. - Smell (Green): perceiving smells gradually drifting inward from the courtyard. - Visual (Blue): experiencing a progressive visual opening toward the courtyard. 2. Courtyard Zone - Auditory (Yellow): distributed across the space. - Smell (Green): dispersed due to plants and open-air ventilation. - Visual (Blue): encompassing the courtyard as a whole. - Haptic (Purple): marked along pathways and edges. - Taste (Red): following the kitchen-to-courtyard transition. 3. Liwan (open space) Zone - Visual (Blue): a clear directional visual axis leading toward the liwan (open space).	1. Entrance zone - Auditory (Yellow): restricted to the doorway area. - Smell (Green): concentrated at the threshold without extending along the corridor. 2. Courtyard Zone - Auditory (Yellow): strongly focused at the fountain. - Smell (Green): intensified at the courtyard’s center. - Visual (Blue): directed primarily toward the fountain. - Haptic (Purple): concentrated on the fountain’s edge. - Taste (Red): similar to Participant 1 but less spatially extended. 3. Liwan (open space) Zone - Visual (Blue): a broader view that encompasses both the liwan (open space) and the courtyard.	Both participants showed similar sensory responses In the entrance, they both activated hearing and smell, noticing the sound of the fountain and the scent drifting in from the inside. At the threshold of the courtyard, both participants showed touch, since this is the moment where they shift from a tight, shaded corridor into an open space. Near the kitchen area, both activated taste, responding to the food-related cues that reach the courtyard. For vision, both participants agreed that the strongest visual moment was in the liwan (open space), looking toward the fountain, which naturally becomes the main focal point of the space.

Table 1. Cont.

sensory map type		
Visual-Oriented Sensory Map	Visual-Haptic Sensory Map	Auditory-Visual Sensory Map
Touma Gate (Bab Touma) Case 2		
		LEGEND - Courtyard space - Liwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Auditory (Yellow): a clear sound path extending from the entrance toward the courtyard and reaching the fountain area. - Smell (Green): a smell line starting at the threshold and lightly entering the corridor. 2. Courtyard Zone - Auditory (Yellow): a faint continuation of the sound line reaching the liwan (open space) threshold and curving around the fountain. - Taste (Red): extending from the kitchen toward the courtyard. - Visual (Blue): a short visual trace along the fountain and near the courtyard entrance. 3. Liwan (open space) Zone - Haptic (Purple): the only sense present in the liwan (open space).	1. Entrance Zone - Auditory (Yellow): present at the doorway and directed inward. - Smell (Green): concentrated at the entrance threshold. 2. Courtyard Zone - Auditory (Yellow): strongly focused toward the fountain. - Haptic (Purple): located near the fountain and extending on two sides. - Taste (Red): a short line positioned in front of the liwan (open space). 3. Liwan (open space) Zone - Visual (Blue): the only sense activated in the liwan (open space), with a clear visual line facing the courtyard and fountain.	Both participants shared similar sensory activations in key areas of the house. In the entrance, they both engaged hearing (yellow) and smell (green), responding to the sound and scent moving from the courtyard toward the corridor. Within the courtyard, their maps overlapped around the fountain through hearing (yellow), visual traces (blue) near the courtyard entrance, and taste (red) along the kitchen-to-courtyard path. In the liwan (open space), no overlapping sense appeared, as each participant experienced this zone through a different modality, resulting in no shared sensory activation in that space.

Table 1. Cont.

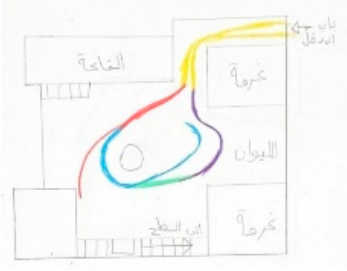
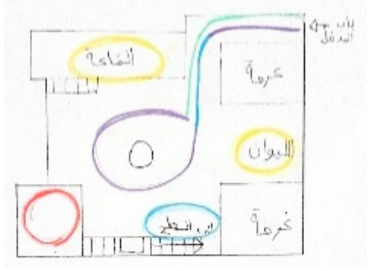
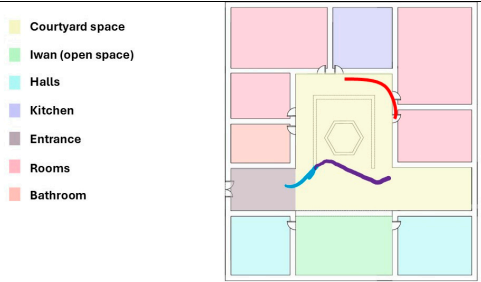
sensory map type		
Auditory Map	Visual–Haptic Map	Auditory–Visual Map
Al Sharqi Gate (Bab Sharqi) Case 3		
		
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Auditory (Yellow): the sound line begins at the entrance and continues inward, reaching the courtyard threshold. 2. Courtyard Zone - Haptic (Purple): appearing after the entrance transition and becoming visible at the liwan (open space) side. - Taste (Red): starting exactly where the yellow line ends at the courtyard entrance and extending directly toward the kitchen. - Visual (Blue): activated at the fountain, forming a clear visual trace that begins at the courtyard center and continues toward the liwan (open space). - Smell (Green): present in the transitional area between the fountain and the liwan (open space). 3. Liwan (open space) Zone - Haptic (Purple): clearly activated inside the liwan (open space) and extending outward beyond the liwan (open space) threshold.	1. Entrance Zone - Smell (Green): a smell line beginning at the entrance and continuing through the corridor, reaching the threshold of the courtyard near the liwan (open space) and the fountain. - Haptic (Purple): present only within the entrance corridor, ending exactly at the transition point into the courtyard. 2. Courtyard Zone - Haptic (Purple): reappearing around the fountain, forming a tactile circle at the courtyard’s core. - Visual (Blue): continuing from the end of the purple line and extending toward the fountain, marking a visual trajectory aimed at the central element of the courtyard, also localized visual trace in the space leading toward the roof. - Auditory (Yellow): present inside the liwan (open space)-facing hall and directed toward the courtyard. - Taste (Red): strongly concentrated in the kitchen. 3. Liwan (open space) Zone - Auditory (Yellow): clearly marked inside the liwan (open space), indicating an acoustic focus toward the sound from the fountain.	Both participants showed clear overlap in the courtyard, where they both activated haptic perception (purple)—one across the entire courtyard and the other closer to the liwan (open space) side. They also agreed on food-linked (red) being centered in the kitchen area. A partial overlap appeared in visual perception (blue) at the entrance of the courtyard, where both maps indicated a visual orientation toward the courtyard’s core.

Table 1. Cont.

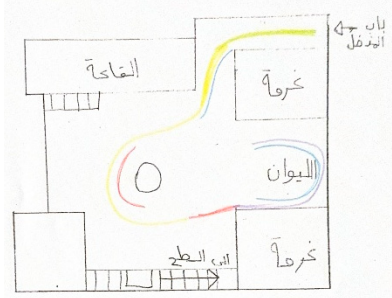
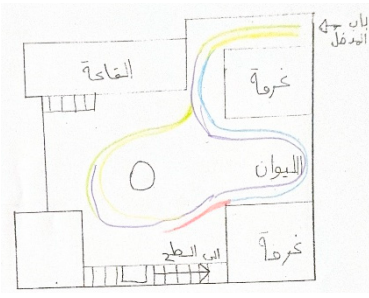
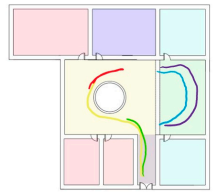
sensory map type		
Visual–Auditory map	Haptic–Visual Map	Haptic Map
Al Sharqi Gate (Bab Sharqi) Case 4		
		LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom 
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Smell (Green): begins as a single smell line extending from the house entrance through the corridor and continues alone until reaching the courtyard threshold. 2. Courtyard Zone - Auditory (Yellow): activated at the courtyard entrance and expands widely around the fountain, indicating strong acoustic awareness of the courtyard core. - Visual (Blue): appears at the courtyard entrance as a short initial visual trace before extending further toward the liwan (open space). - Food-linked (Red): activated in two locations, one near the fountain and another adjacent to the kitchen. 3. Liwan (open space) Zone - Haptic (Purple): clearly activated within the liwan (open space), forming a continuous path parallel to the visual line. - Visual (Blue): reappears inside the liwan (open space), running parallel to the haptic line, indicating a combined visual–tactile engagement in this space.	1. Entrance Zone - Auditory (Yellow): activated clearly at the house entrance, forming a sound line that extends from the doorway toward the transition into the courtyard. - Smell (Green): two parallel smell lines run along the entrance corridor. 2. Courtyard Zone - Visual (Blue): begins at the threshold of the courtyard and continues as a curved path toward the liwan (open space). - Haptic (Purple): emerges at the courtyard entrance and extends toward the liwan (open space), then loops around the fountain. - Auditory (Yellow): reappears around the fountain, suggesting that sound becomes more noticeable at the courtyard core. - Smell (Green): also activated near the fountain, reflecting intensified scents around the open courtyard. - Food-linked (Red): appears as a short line extending from the kitchen toward the fountain. 3. Liwan (open space) Zone - Visual (Blue): continues into the liwan (open space) from the courtyard entrance. - Haptic (Purple): also extends into the liwan (open space) before looping back toward the fountain.	Both participants activated smell (green) in the entrance as the main sensory cue leading toward the courtyard. In the courtyard, they shared visual (blue) at the courtyard entrance and auditory (yellow) around the fountain, marking the courtyard core as a common acoustic point. They also linked the kitchen to the courtyard through food-linked (red). In the liwan (open space), both participants activated visual (blue) and haptic (purple), showing a shared visual–tactile reading of this space.

Table 1. Cont.

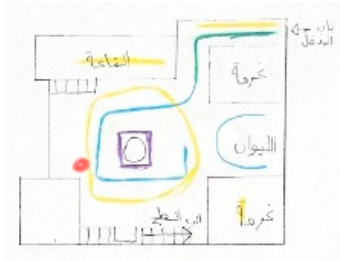
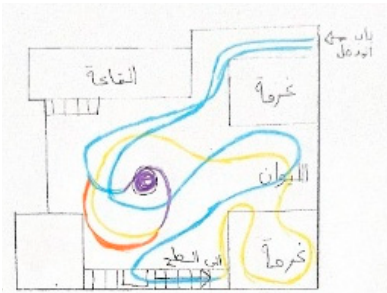
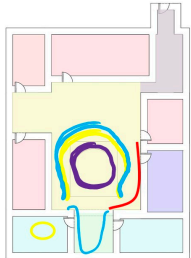
sensory map type		
Auditory Map	Auditory Haptic Map	Visual–Auditory–Haptic Map
Qaysan Gate (Bab Qaysan) Case 5		
		LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom 
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Auditory (Yellow): a hearing line appears at the entrance and stops immediately after the entrance corridor ends. - Smell (Green): a smell line continues from the entrance all the way to the courtyard threshold. 2. Courtyard Zone - Visual (Blue): replaces the green line at the courtyard entrance and forms a continuous path circling the fountain, extending across the courtyard and reaching the liwan (open space). - Auditory (Yellow): reappears as a large circular ring around the fountain, with an additional small yellow trace inside the room adjacent to the liwan (open space) and a light trace in the hall. - Haptic (Purple): concentrated as a small circular activation directly around the fountain. - Food-linked (Red): a small red point located between the kitchen and the courtyard. 3. Liwan (open space) Zone - Visual (Blue): showing in the liwan (open space) as part of the extended visual path from the courtyard.	1. Entrance Zone - Visual (Blue): begins at the entrance door and continues through the entire entrance corridor toward the courtyard. 2. Courtyard Zone - Visual (Blue): expands across the full courtyard space, looping around the fountain, entering the liwan (open space), and extending further toward the staircase leading to the roof. - Auditory (Yellow): starts at the fountain, then curves toward the liwan (open space), passes into the adjacent room, and ends at the roof staircase. - Haptic (Purple): appears as a circular tactile activation at the fountain itself. - Food-linked (Red): a curved red line between the kitchen and the courtyard. 3. Liwan (open space) Zone - Visual (Blue): continues into the liwan (open space) as part of the main visual trajectory. - Auditory (Yellow): also extends into the liwan (open space) as part of the curved sound path originating at the fountain	In both maps, the fountain acted as the main sensory anchor: visual traces (blue) surrounded it, auditory presence (yellow) appeared clearly near it, and a haptic indication (purple) formed a circular gesture. They also showed agreement in positioning food-linked (red) near the transitional zone between the kitchen and the courtyard. Beyond the courtyard, both participants also shared similar activations near the liwan (open space), where blue (visual). Likewise, in the room adjacent to the liwan (open space), both maps included yellow (auditory).

Table 1. Cont.

sensory map type		
Auditory Map	Visual–Auditory Map	Visual–Auditory Map
Qaysan Gate (Bab Qaysan) Case 6		
		LEGEND - Courtyard space - Liwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Haptic (Purple): activated at the entrance extending until the threshold of the courtyard. 2. Courtyard Zone - Visual (Blue): appears immediately upon entering the courtyard as a curved line moving toward the fountain, but stops once reaching the fountain's edge. - Auditory (Yellow): the dominant sensory element, forming a full circular loop around the courtyard and fountain, and continuing toward the liwan (open space). - Haptic (Purple): reappears around the fountain as a curved line. - Food-linked (Red): shown as a central red circle inside the fountain area. 3. Liwan (open space) Zone - Auditory (Yellow): continues into the liwan (open space) as part of the extended curved path. - Visual (Blue): present at the liwan (open space) entrance as curved line.	1. Entrance Zone - Auditory (Yellow): activated at the entrance, forming the initial sensory pathway toward the courtyard. 2. Courtyard Zone - Smell (Green): appears at the courtyard threshold, replacing the yellow line as the participant moves inward. - Visual (Blue): emerges near the fountain and merges with the purple line, continuing together toward the liwan (open space). - Haptic (Purple): activated around the fountain in parallel with the blue visual line. - Food-linked (Red): appears as a short curved line between the kitchen and the courtyard. 3. Liwan (open space) Zone - Visual (Blue): continues from the courtyard into the liwan (open space) as a sensory line. - Haptic (Purple): also continues into the liwan (open space) beside the blue line, forming a dual visual–tactile perception in this space.	In the courtyard zone, visual (blue) and haptic (purple) were present in both maps, particularly near the fountain, where each participant highlighted these senses as key perceptual elements. In the liwan (open space) zone, both participants expressed a visual (blue) continuation from the courtyard into the liwan (open space).

Table 1. Cont.

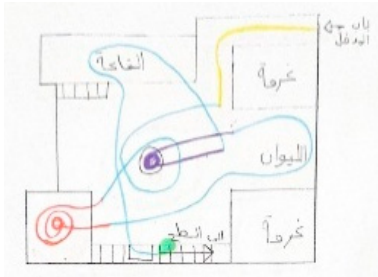
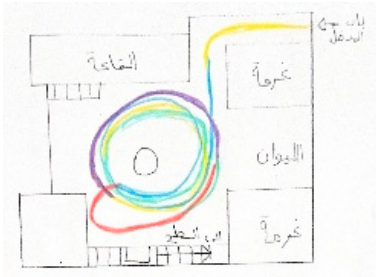
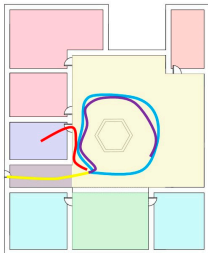
sensory map type		Visual Map
Auditory Map	Visual–Haptic Map	
Al-Saghir Gate (Bab Al-Saghir) Case 7		
		LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom 
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Auditory (Yellow): activated at the entrance and continues only until the courtyard threshold. 2. Courtyard Zone - Visual (Blue): the dominant sensory element, forming a curved path around the fountain and extending into the liwan (open space), the hall, and the rooms surrounding the courtyard. - Haptic (Purple): activated at the fountain and extending toward the liwan (open space), but does not enter the liwan (open space) space. - Food-linked (Red): activated in the kitchen and slightly extending into the courtyard. - Smell (Green): appears only near the staircase leading to the roof. 3. Liwan (open space) Zone - Visual (Blue): the only sense that continues into the liwan (open space) as part of the dominant visual trajectory.	1. Entrance Zone - Auditory (Yellow): activated at the entrance but stops immediately before entering the courtyard. 2. Courtyard Zone - Visual (Blue): strongly activated around the fountain, forming part of the central courtyard perception. - Haptic (Purple): present around the fountain, overlapping with the blue visual trace. - Auditory (Yellow): reappears around the fountain. - Smell (Green): activated around the fountain. - Food-linked (Red): appears near the kitchen and curves toward the fountain. 3. Liwan (open space) Zone - No extended sensory lines reach into the liwan (open space); most sensory activity remains concentrated around the fountain.	In both maps, visual (blue) was activated prominently in the fountain. Similarly, haptic (purple) appeared around the fountain for both participants. Auditory (yellow) also appeared in the entrance for both participants. In addition, food-linked (red) was present near the kitchen in both cases, extending toward the courtyard.

Table 1. Cont.

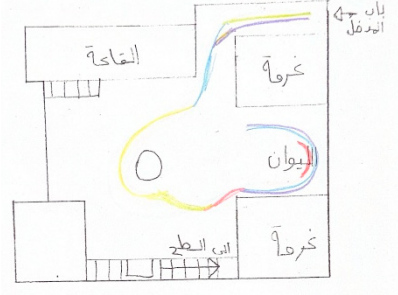
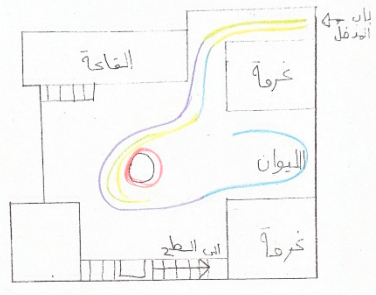
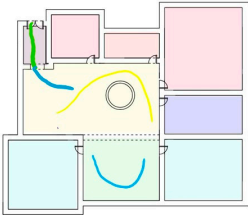
sensory map type		
Visual Map	Auditory Map	Visual–Haptic Map
Al-Saghir Gate (Bab Al-Saghir) Case 8		
		LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom 
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Smell (Green): appears as a continuous smell line running parallel to the purple line along the entire entrance corridor. - Haptic (Purple): activated in a parallel path beside the green line. 2. Courtyard Zone - Visual (Blue): begins at the courtyard threshold and extends toward the fountain. - Auditory (Yellow): activated near the fountain, forming a curved line that wraps around the fountain area and continues toward the kitchen. - Food-linked (Red): appears at the kitchen, extending slightly outward in a short curved line toward the courtyard. 3. Liwan (open space) Zone - Visual (Blue): reappears strongly inside the liwan (open space), covering the interior space. - Haptic (Purple): also present throughout the liwan (open space) interior. - Food-linked (Red): appears again as a small curved red trace inside the liwan (open space).	1. Entrance Zone - Smell (Green): activated at the entrance and extending forward as a straight line toward the courtyard. - Auditory (Yellow): runs parallel to the green line along the entrance corridor, forming a dual-sensory entry path. 2. Courtyard Zone - Visual (Blue): begins at the courtyard threshold, extending into the courtyard before stopping at the fountain. - Haptic (Purple): emerges at the same threshold and continues as a curved tactile line around the fountain, extending toward the space in front of the liwan (open space) but not entering the liwan (open space) interior. - Auditory + Smell (Yellow & Green): both senses reappear together around the fountain after the blue line stops, marking a combined sound–smell activation at the courtyard core. - Food-linked (Red): activated around the fountain in circular movements. 3. Liwan (open space) Zone - Visual (Blue): reappears inside the liwan (open space).	In the entrance zone, smell (green) appeared in both maps as a continuous smell line guiding the movement toward the courtyard. Around the fountain, their sensory patterns converged again: both participants activated visual (blue) at the courtyard threshold and used yellow (auditory) near the fountain and both participants showed visual (blue) within the liwan (open space) zone.

Table 1. Cont.

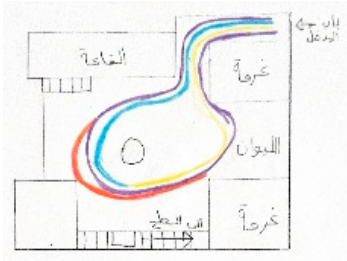
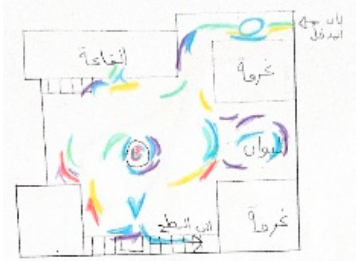
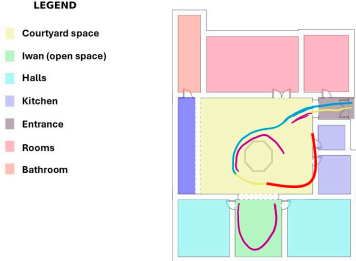
sensory map type		
Visual–Haptic–Auditory Map	Haptic Map	Visual Map
Al-Jabiya gate (Bab Al-Jabiya) Case 9		
		
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Haptic (Purple): the dominant sensory line at the entrance, beginning at the doorway and extending continuously toward the courtyard. - Visual (Blue): activated at the entrance and extending forward until reaching the fountain area. - Auditory (Yellow): also present at the entrance, forming part of the initial pathway. 2. Courtyard Zone - Haptic (Purple): continues strongly through the courtyard, passing around the fountain, moving into the liwan (open space) area, the surrounding rooms, and looping back toward the entrance, creating a wide tactile circulation pattern. - Visual (Blue): extends from the entrance into the courtyard but stops upon reaching the fountain. - Auditory (Yellow): replaces the blue line after the fountain and continues as a curved auditory path through the liwan (open space) and back toward the entrance, forming an extended circular movement. - Food-linked (Red): activated near the fountain on the kitchen-facing side, extending toward the liwan (open space) but stopping before entering the liwan (open space) interior.	1. Entrance Zone - Smell (Green): activated along the entrance corridor as an uninterrupted line leading toward the courtyard. - Auditory (Yellow): runs parallel to the green line, forming a dual-sensory entry path. - Visual (Blue): appears as a single activation point in the middle of the entrance corridor. 2. Courtyard Zone - Visual (Blue) & Haptic (Purple): both senses are activated simultaneously at the threshold between the entrance and the courtyard. - The participant activated nearly all sensory colors (yellow, green, blue, purple, and some red) within the rooms surrounding the courtyard - Smell (Green): lightly activated near the fountain, marking selective smell perception. - Auditory (Yellow): present around the courtyard in multiple points. - Visual (Blue): the most dominant sense in the courtyard, activations around the fountain. - Haptic (Purple): activated in a medium intensity pattern around the fountain. - Food-linked (Red): appears as a small red circle inside the fountain.	In both maps, visual (blue) and auditory (yellow) were activated at the entrance. At the threshold between the entrance and the courtyard, visual (blue) and haptic (purple) also appeared in both maps. Within the courtyard, both participants highlighted visual (blue) around the fountain, while haptic (purple) also appeared prominently in this area for both. They additionally shared the presence of auditory (yellow) near the liwan (open space). Food-linked (red) appeared in both maps close to the fountain on the kitchen-facing side. In the liwan (open space), both participants activated haptic (purple).

Table 1. Cont.

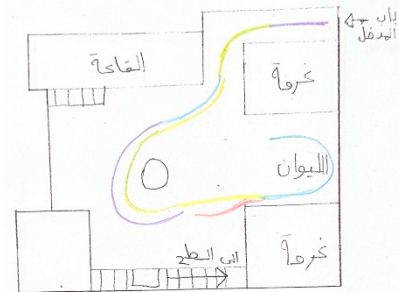
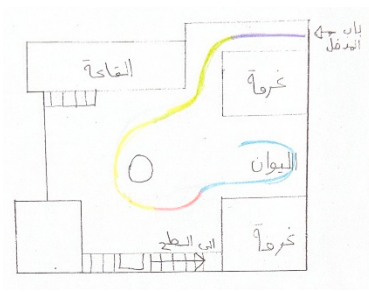
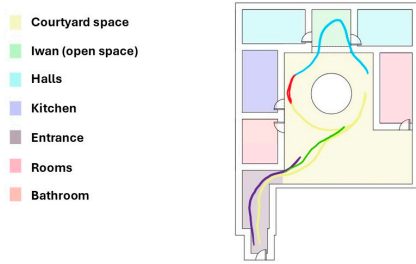
3. Liwan (open space) Zone		3. Liwan (open space) Zone	
• Auditory (Yellow): continues through the liwan (open space) as part of the extended sound path originating near the fountain. • Haptic (Purple): present around the liwan (open space) as part of the broad tactile route circulating through the courtyard.		• Visual (Blue): activated inside the liwan (open space) as continued visual perception from the courtyard. • Haptic (Purple): present inside the liwan (open space) alongside blue.	
sensory map type			
Haptic Map	Visual Map	Haptic Map	
Al-Jabiya gate (Bab Al-Jabiya) Case 10			
		LEGEND Courtyard space Iwan (open space) Halls Kitchen Entrance Rooms Bathroom 	
Participant 1	Participant 2	Summary of Similarities	
1. Entrance Zone		Both participants showed overlap in how they activated the entrance and courtyard zones. In the entrance, haptic (purple) appeared in both maps. As they approached the courtyard, both participants activated smell (green) near the fountain area. Within the courtyard, both maps also highlighted auditory (yellow) in relation to the fountain either as a curved loop or as repeated points of sound perception. Food-linked (red) appeared in both cases near the kitchen-facing side of the courtyard, extending slightly toward the fountain. In the liwan (open space), both participants activated visual (blue).	
• Haptic (Purple): activated at the entrance as the first sensory line.			
2. Courtyard Zone			
• Smell (Green): appears as the participant moves from the entrance toward the courtyard, activated near the fountain area. • Auditory (Yellow): begins near the fountain and forms a curved path around it. • Food-linked (Red): appears as a small curved line near the kitchen-facing side of the fountain.			
3. Liwan (open space) Zone		1. Entrance Zone	
• Visual (Blue): activated inside the liwan (open space) as a continued perceptual line.		• Haptic (Purple): activated at the entrance as the initial sensory line. • Smell (Green): appears midway through the entrance corridor and continues toward the courtyard threshold.	
		2. Courtyard Zone	
		• Smell (Green): reappears around the fountain. • Haptic (Purple): also reappears around the fountain. • Auditory (Yellow): activated in two separate locations once between the entrance and the fountain, and again between the fountain and the liwan (open space). • Food-linked (Red): appears in the kitchen area and extends toward the fountain as a short line that does not reach the courtyard center.	
		3. Liwan (open space) Zone	
		• Visual (Blue): present inside the liwan (open space), and also appears once in small area between the entrance corridor and the fountain, without reaching the fountain itself.	

Table 1. Cont.

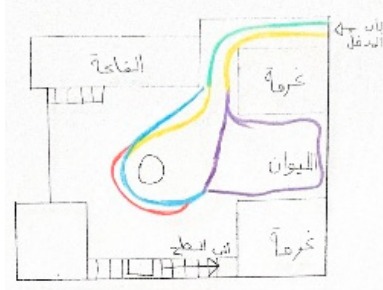
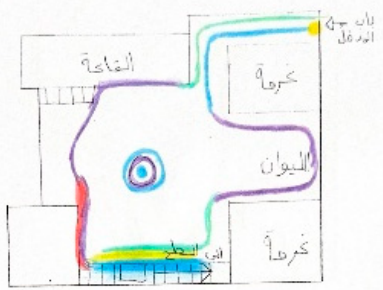
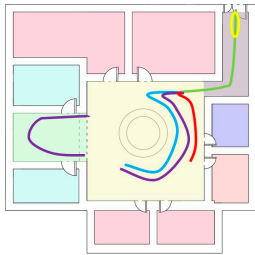
sensory map type		
Auditory Map	Auditory Map	Auditory Map
A-Faradis Gate (Bab Al-Faradis) Case 11		
		LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom 
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Smell (Green): activated at the entrance but stops immediately upon entering the courtyard. - Auditory (Yellow): continues from the entrance through the corridor and remains active until reaching the fountain area. 2. Courtyard Zone - Visual (Blue): begins at the courtyard threshold, forming a curved path that circles around the fountain and stops near the liwan (open space). - Food-linked (Red): appears as a small curved line near the fountain. - Auditory (Yellow): active until reaching the fountain area. - Haptic (Purple): activated directly in front of the fountain and also inside the liwan (open space). 3. Liwan (open space) Zone - Haptic (Purple): present inside the liwan (open space).	1. Entrance Zone - Auditory (Yellow): activated as a single point at the entrance, extending into a blue path. - Visual (Blue): continues from the entrance and leads toward the courtyard. - Smell (Green): also activated at the entrance and extends until reaching the courtyard threshold. 2. Courtyard Zone - Haptic (Purple): strongly activated around the fountain and within parts of the courtyard. - Food-linked (Red): appears near the kitchen and extends slightly toward the fountain. - Smell (Green): present in the surrounding rooms of the courtyard. - Visual (Blue): appears within the fountain and surrounding rooms of the courtyard. 3. Liwan (open space) Zone - Haptic (Purple): activated inside the liwan (open space).	In both maps, auditory (yellow) was present at the entrance. Upon entering the courtyard, both participants activated visual (blue) around the fountain area. They also shared haptic (purple) activation at the fountain and inside the liwan (open space). Food-linked (red) appeared near the kitchen-facing side of the courtyard in both maps. Additionally, smell (green) was present in both participants' entrance experience.

Table 1. *Cont.*

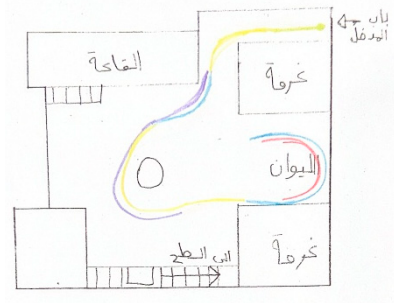
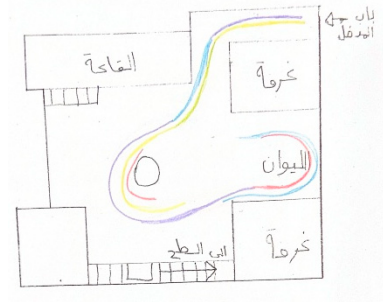
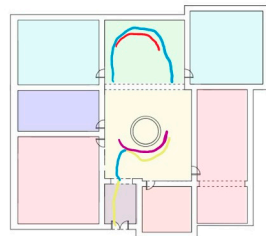
sensory map type		
Visual-Haptic-Auditory Map	Visual-Haptic Map	Haptic Map
A-Faradis Gate (Bab Al-Faradis) Case 12		
		LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom 
Participant 1	Participant 2	Summary of Similarities
- Entrance Zone - Smell (Green): activated at the entrance but stops halfway through the corridor. - Auditory (Yellow): continues from the midpoint of the entrance corridor until reaching the courtyard threshold. - Courtyard Zone - Haptic (Purple): activated at the courtyard threshold and continues fully around the fountain, forming a continuous tactile loop. - Visual (Blue): activated at the courtyard entrance but stops shortly before reaching the fountain. - Auditory (Yellow): reactivated near the fountain and circles around it, continuing toward the liwan (open space) but stopping before entering the space. - Liwan (open space) Zone - Food-linked (Red): activated inside the liwan (open space). - Visual (Blue): also activated within the liwan (open space).	- Entrance Zone - Haptic (Purple): activated at the entrance. - Auditory (Yellow): activated from the entrance corridor. - Courtyard Zone - Visual (Blue): activated at the courtyard threshold and moves toward the fountain area. - Smell (Green): activated alongside blue until reaching the middle of the courtyard near the fountain. - Auditory (Yellow): reactivated near the fountain and forms a curved loop around it. - Haptic (Purple): also activated around the fountain, looping toward the liwan (open space) but stopping before entering. - Food-linked (Red): activated near the fountain on the kitchen facing side. - Liwan (open space) Zone - Food-linked (Red): activated inside the liwan (open space). - Visual (Blue): also activated inside the liwan (open space).	At the entrance, auditory (yellow) appeared in both maps. At the courtyard threshold, both participants activated visual (blue). Around the fountain, they also shared the activation of auditory (yellow) and haptic (purple), each forming curved sensory traces in response to the central courtyard element. Additionally, both participants activated food-linked (red) inside the liwan (open space), and both marked visual (blue) within the liwan (open space).

Table 1. Cont.

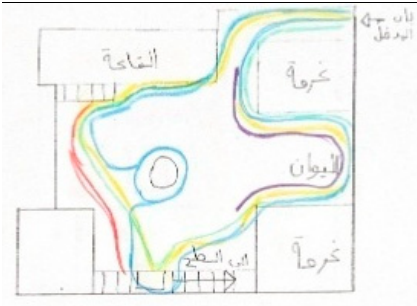
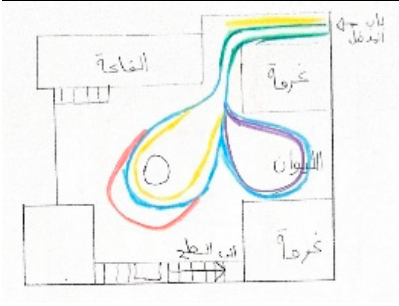
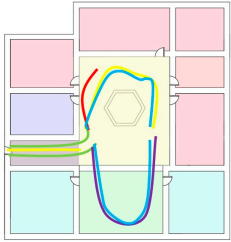
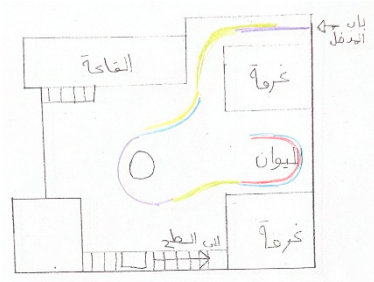
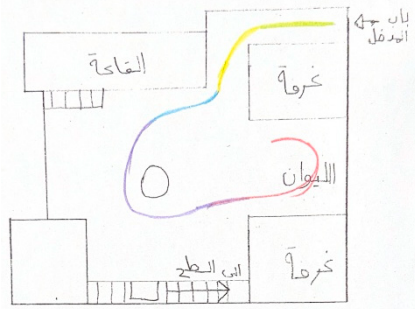
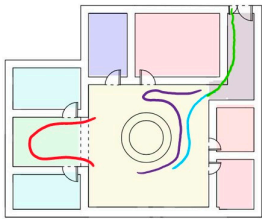
sensory map type		
Auditory Map	Visual–Haptic Map	Visual Map
Al-Salam Gate (Bab al-Salam) Case 13		
		LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom 
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Auditory (Yellow): activated at the entrance and continues as a continuous path into the courtyard, around the fountain, and into the liwan (open space). - Visual (Blue): also activated at the entrance and continues through the courtyard and into the liwan (open space). - Smell (Green): begins at the entrance and extends toward the fountain area. 2. Courtyard Zone - Auditory (Yellow): forms a wide loop around the fountain and extends toward the liwan (open space). - Visual (Blue): circles the courtyard and continues into the liwan (open space). - Smell (Green): activated throughout the courtyard, including around the fountain. - Food-linked (Red): appears near the kitchen-facing side of the courtyard. 3. Liwan (open space) Zone - Haptic (Purple): strongly activated inside the liwan (open space) and extending slightly outward. - Visual (Blue): continues inside the liwan (open space). - Smell (Green): may briefly appear near the liwan (open space) edges. - Auditory (Yellow): extends toward the liwan (open space). 1. Entrance Zone - Auditory (Yellow): activated at the entrance but remains limited to the entry corridor only. - Smell (Green): begins at the entrance and continues forward until reaching the courtyard threshold, where it stops. 2. Courtyard Zone - Visual (Blue): becomes active at the courtyard entrance and forms a wide continuous path circling the courtyard, wrapping around the fountain, and extending into the liwan (open space). - Auditory (Yellow): reappears around the courtyard, forming a curved loop around the fountain. - Food-linked (Red): activated around the fountain in localized red line. - Haptic (Purple): activated inside the liwan (open space) as a distinct tactile trace. 3. Liwan (open space) Zone - Visual (Blue): continues inside the liwan (open space) as part of the extended visual route. - Haptic (Purple): clearly present inside the liwan (open space). In the entrance zone, they both activated auditory (yellow) and smell (green) as the initial perceptual cues when moving from the corridor toward the courtyard. Within the courtyard zone, the strongest similarities appeared around the fountain: both participants highlighted visual (blue), and both also activated auditory (yellow) in this central area. Additionally, food-linked (red) appeared in both maps near the kitchen-facing side of the courtyard. In the liwan (open space) zone, both participants activated haptic (purple) and visual (blue), demonstrating a shared tactile–visual engagement with the liwan (open space).		

Table 1. Cont.

sensory map type		
Auditory–Visual–Smelling Map	Visual Map	Visual Map
Al-Salam Gate (Bab al-Salam) Case 14		
		LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom 
Participant 1	Participant 2	Summary of Similarities
1. Entrance Zone - Haptic (Purple): activated at the entrance and remains the line in this corridor. - Smell (Green): appears toward the corridor and continues until the courtyard threshold. 2. Courtyard Zone - Auditory (Yellow) & Visual (Blue): both activated at the courtyard entrance and continue together toward the fountain. - Haptic (Purple): activated at the fountain and forms a curved tactile path around it. - Smell (Green): appears again near the liwan (open space) side of the courtyard. 3. Liwan (open space) Zone - Food-linked (Red): activated inside the liwan (open space). - Visual (Blue): also activated inside the liwan (open space).	1. Entrance Zone - Smell (Green): activated at the entrance and continues through most of the corridor. - Auditory (Yellow): begins near the end of the entrance corridor and extends toward the courtyard threshold. 2. Courtyard Zone - Visual (Blue): activated at the start of the courtyard and continues toward the fountain. - Haptic (Purple): activated near the fountain and forms a curved path leading toward the liwan (open space). 3. Liwan (open space) Zone - Food-linked (Red): activated inside the liwan (open space) area.	In the entrance zone, they both activated smell (green) as a perceptual cue guiding the movement toward the courtyard. Within the courtyard, both participants highlighted visual (blue) at the courtyard entrance. Around the fountain area, both participants activated haptic (purple) In the liwan (open space) zone, both participants activated food-linked (red) inside the liwan (open space).

4.2. Level 2—Gate-Level Synthesis

In the second level of analysis, the two House-Level Sensory Maps for the two case studies within each gate district were combined to create one Gate-Level Sensory Map. The aim was to preserve the full range of sensory traces visible across the two houses while making the strength of shared traces explicit. When the same sense appeared in comparable locations on both house-level maps, it was interpreted as a strong and stable feature of that gate district. When a sense appeared in only one of the two cases, it was retained in the gate-level synthesis but treated as lower intensity, reflecting weaker cross-case consistency rather than absence. The resulting gate map therefore combines all traced senses while distinguishing between shared versus less consistent sensory activations, providing a complete representation of the gate district's sensory character. Figure 8 and Table 2 show the Old City gate-based organization used to group the case studies for the gate-level synthesis.

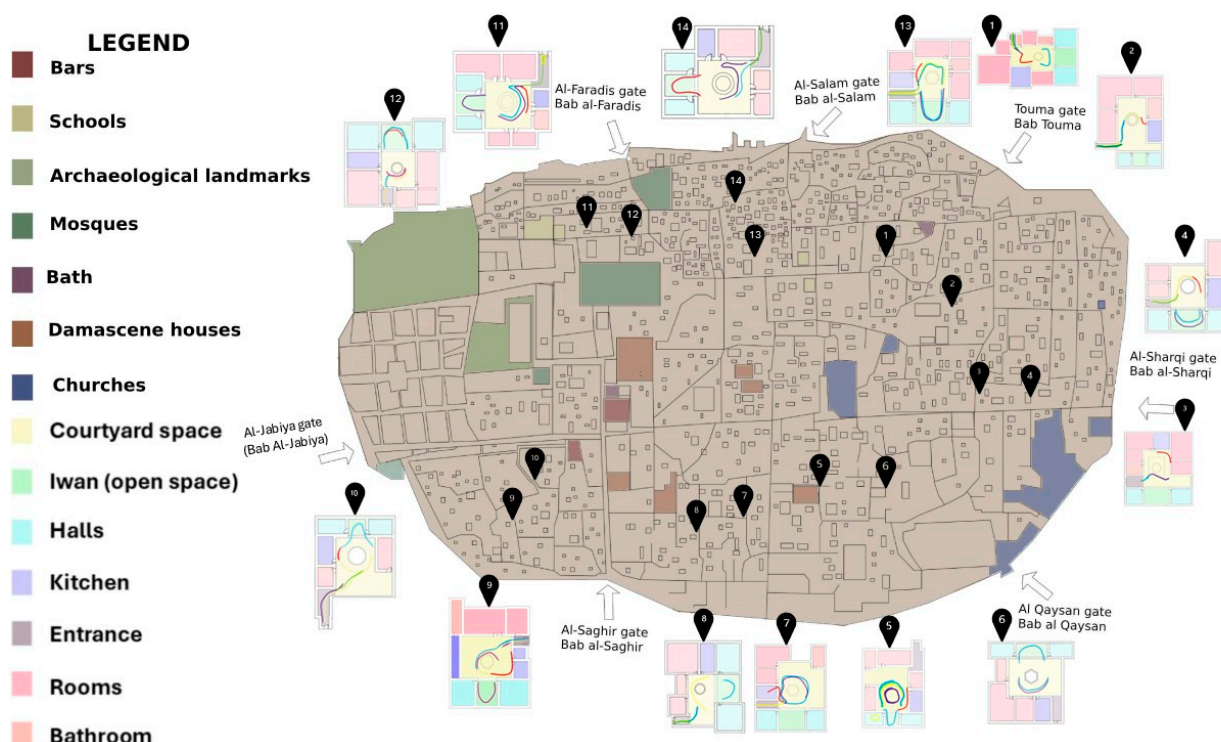


Figure 8. A map of the old city of Damascus showing the locations of the sensory maps. The arrows represent the locations of the seven historic gates surrounding the Old City. Colored lines represent different types of sensory perception: Yellow—Auditory, Green—Smell, Blue—Visual, Purple—Haptic, Red—Taste.

4.3. Level 3—City-Level Synthesis

Level 3 synthesizes the seven gate-level sensory maps to establish a unified sensory framework for the Damascene courtyard house. Through cross-case comparison, recurring patterns such as where each sense originates, intensifies, or converges are extracted to construct a comprehensive sensory model. Figure 9 and Table 3 summarize the recurring city-level spatial patterns identified for each sensory domain across the seven gates.

Table 2. Level 2—Gate-Level Synthesis of sensory mappings for paired houses within each gate district.

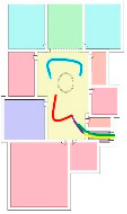
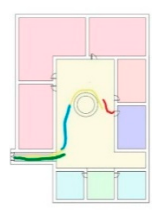
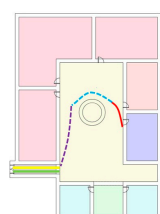
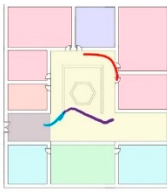
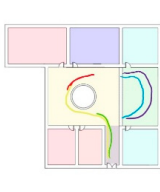
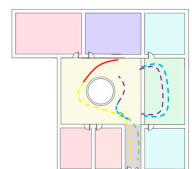
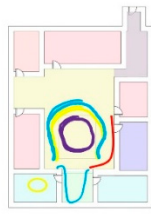
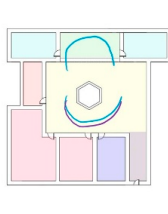
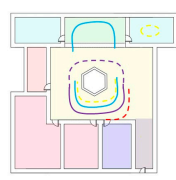
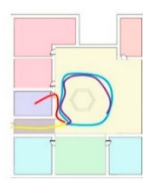
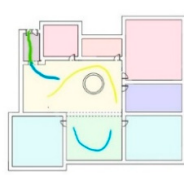
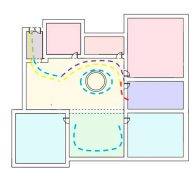
Gate	Case 1 Sensory Map	Case 2 Sensory Map	Interpretation	Final Gate Sensory Map
Touma Gate (Bab Touma)			Across both maps, the entrance shows the clearest agreement: auditory (yellow) and smell (green) appear in the same place, so they are considered the Strong senses for this gate. In the courtyard, food-linked (red) also appears in almost the same location near the kitchen side and toward the fountain, making it another Strong sense. Visual (blue) and haptic (purple) appear in both maps but follow different paths, so they are classified as Low-Intensity. Strong-intensity: Yellow, Green, Red Low-intensity: Blue, Purple	 LEGEND  Courtyard space  Iwan (open space)  Halls  Kitchen  Entrance  Rooms  Bathroom
Al Sharqi Gate (Bab Sharqi)			Across both maps, the strongest overlap appears around the fountain, where food-linked (red) is placed in nearly the same spot, making it the main Strong sense for this gate. Visual (blue) and haptic (purple) also show up in both maps but with different shapes and directions, so they are Low-Intensity. Auditory (yellow) and smell (green) appear only once across the two maps and are therefore also Low-Intensity. Strong-intensity: Red Low-intensity: Blue, Purple, Yellow, Green	 LEGEND  Courtyard space  Iwan (open space)  Halls  Kitchen  Entrance  Rooms  Bathroom
Qaysan Gate (Bab Qaysan)			Across both maps, visual (blue) and haptic (purple) show the clearest agreement, especially around the fountain where both follow similar curved paths. These two senses are therefore the Strong ones for this gate. The remaining senses—food-linked (red), auditory (yellow), and smell (green)—appear in different locations across the maps, so they are considered Low-Intensity. Strong-intensity: Blue, Purple Low-intensity: Red, Yellow, Green	 LEGEND  Courtyard space  Iwan (open space)  Halls  Kitchen  Entrance  Rooms  Bathroom
Al-Saghir Gate (Bab Al-Saghir)			Across both maps, no sense appears in the same location, so there is no Strong sense for this gate. All senses are present, but each one appears differently between the two maps, so they are all considered Low-Intensity. Low-intensity: Red, Yellow, Green, Blue, Purple	 LEGEND  Courtyard space  Iwan (open space)  Halls  Kitchen  Entrance  Rooms  Bathroom

Table 2. Cont.

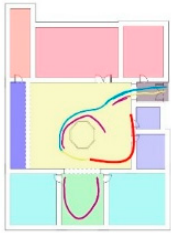
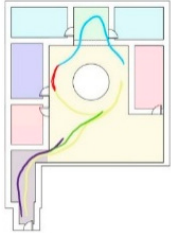
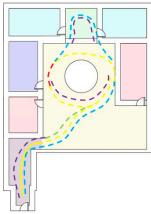
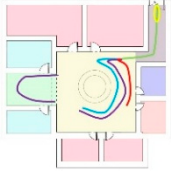
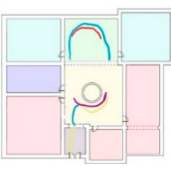
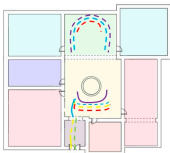
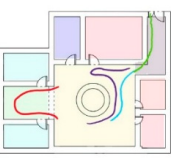
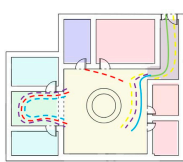
Gate	Case 1 Sensory Map	Case 2 Sensory Map	Interpretation	Final Gate Sensory Map
Al-Jabiya gate (Bab Al-Jabiya)			Across both maps, auditory (yellow) shows clear agreement at the entrance, making it a Strong shared sense. Food-linked (red) also appears in the same general area near the kitchen side and the fountain, so it is another Strong sense. Visual (blue) and haptic (purple) appear in both maps but with different routes, and smell (green) appears only once, so they are classified as Low-Intensity. Strong-intensity: Red, Yellow Low-intensity: Blue, Purple, Green	 LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom
A-Faradis Gate (Bab Al-Faradis)			Across both maps, auditory (yellow) appears in the entrance, while visual (blue) and haptic (purple) appear around the fountain in the same general areas. These shared locations make them the Strong senses for this gate. Food-linked (red) and smell (green) appear in different positions between the two maps, so they are treated as Low-Intensity. Strong-intensity: Yellow, Blue, Purple Low-intensity: Red, Green	 LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom
Al-Salam Gate (Bab al-Salam)			Across both maps, smell (green) appears in the same place at the entrance, so it is considered a Strong shared sense. Visual (blue) also appears around the fountain in both maps, even though one participant extends it further into the liwan (open space); this overlap makes it another Strong sense. The other senses differ between the two maps: haptic (purple) shifts between the fountain and the liwan (open space), auditory (yellow) appears only once, and food-linked (red) is placed in different spots, so they are all Low-Intensity. Strong-intensity: Green, Blue Low-intensity: Purple, Yellow, Red	 LEGEND - Courtyard space - Iwan (open space) - Halls - Kitchen - Entrance - Rooms - Bathroom

Table 3. Analysis of the second phase of sensory maps in Damascene houses.

Sense	Colour	Common Spatial Pattern Across the Seven Gates	Shared Gates (Where This Pattern Appears Clearly)
Auditory Perception	Yellow	Appears at the entrance in almost all gates, often extending as a directional path toward the fountain. This pattern represents the first sensory activation when entering the courtyard.	Bab Touma, Bab Sharqi, Bab Qaysan, Bab Al-Saghir, Bab Al-Jabiya, Bab Al-Faradis, Bab Al-Salam
Smell Perception	Green	Most consistently anchored at the entrance area, where airflow at the door and corridor transition makes courtyard-related scents legible early in the sequence. Secondary olfactory traces may extend into the courtyard and become more noticeable near planting edges, the fountain, or the liwan (open space) direction depending on ventilation, flowering/watering, and transient household activities, but the strongest cross-case shared anchor remains the entrance.	Bab Touma, Bab Sharqi, Bab Al-Saghir, Bab Al-Jabiya, Bab Al-Faradis, Bab Al-Salam

Table 3. Cont.

Sense	Colour	Common Spatial Pattern Across the Seven Gates	Shared Gates (Where This Pattern Appears Clearly)
Visual Perception	Blue	Strongly concentrated around the fountain, forming a visible circular path in nearly all gates. Also extends toward or inside the liwan (open space), marking it as a major visual node.	All seven gates (Touma, Sharqi, Qaysan, Al-Saghir, Al-Jabiya, Al-Faradis, Al-Salam)
Haptic Perception	Purple	Primarily found around the fountain (continuous or dotted), indicating tactile engagement with movement around this central element. In several gates it also appears toward the liwan (open space).	Bab Touma, Bab Sharqi, Bab Qaysan, Bab Al-Saghir, Bab Al-Jabiya, Bab Al-Faradis, Bab Al-Salam
Food-linked Perception	Red	Originates from the kitchen and moves toward the fountain in the seven gates. This is the strongest recurring pathway, combining functional and experiential aspects of food preparation and shared space.	All seven gates



Figure 9. A map of the Old City of Damascus showing the locations of the seven historic gates (indicated by arrows) and the Gate-Level Sensory Maps for each district. Line types represent intensity levels of sensory traces: solid lines indicate strong-intensity (shared across both cases), while dotted lines indicate low-intensity (present in only one case).

5. Results and Discussions

Auditory Perception (Yellow)

The fountain’s constant sound serves as a fixed element in the auditory experience across all maps, particularly at the entrance, where it is encountered even before the participant fully enters the courtyard. The presence of auditory engagement near the fountain in several maps reflects the way sound moves through old Damascene houses, where architectural features and open courtyards influence the spatial distribution of sound.

Haptic Perception (Purple)

The fountain functions as a tactile center, drawing participants into direct physical engagement with the water or its surroundings. The liwan (open space) also acts as a tac-

tile focal area due to its spatial openness and its seamless relationship with the courtyard, making it a prominent sensory position within the layout.

Gustatory (Taste-Related) Perception (Red)

The maps show gustatory (taste-related, food-linked) perception as originating in the kitchen and extending toward the fountain, tracing the transition from preparation toward shared gathering and eating routines. This pattern indicates the kitchen's role in food-related activity and its spatial relationship to courtyard zones where communal interaction and consumption commonly occur, rather than suggesting literal tasting of architectural surfaces.

Smelling Perception (Green)

The green-smelling perception pathway is most consistently anchored at the entrance, where the door opening and corridor transition make courtyard scents noticeable early in the sequence. In several cases, secondary smell traces extend beyond the threshold into the courtyard and can become more noticeable near planting edges, the fountain area, or toward the liwan (open space) direction depending on ventilation, flowering/watering, and transient household activity. This configuration implies that vegetation and water-related humidity can contribute to olfactory experience while still keeping the entrance as the most stable shared anchor across cases.

Visual Perception (Blue)

The fountain and the liwan (open space) dominate visual perception. The fountain marks the participant's first visual contact with the space, while the liwan (open space) functions as a visual node due to its raised and open position in relation to the courtyard. Both elements maintain visibility and draw attention, supporting their central role in the spatial experience.

The repeated sensory sequence can be interpreted as a structured experiential script produced by the courtyard–house typology rather than as a set of isolated sensory hotspots. At the threshold, the narrow entrance corridor operates as an experiential compression: reduced visual depth and filtered exterior noise make subtle cues—especially the approach of water sound and the anticipation of courtyard openness—more salient as lived experience (phenomenology). From an affordance perspective, the corridor's constricted width and controlled turning geometry discourage lingering and instead afford directed movement toward the courtyard opening, while simultaneously supporting privacy by limiting direct sightlines. In semiotic terms, the corridor functions as a signifying boundary that marks a transition from public street life to domestic interior order, with the shift in acoustic character acting as a legible cue of entry into a different social realm. At the courtyard center, sensory convergence reflects a typological emphasis on orientation and gathering. Phenomenologically, the courtyard supports bodily recalibration through light, temperature, and openness; the shift from compression to release becomes a memorable bodily event. As an affordance structure, the courtyard's clear centrality and circulation geometry invite movement around the fountain and facilitate face-to-face interaction, which helps explain why multiple senses cluster there across cases. Semiotic readings treat the courtyard center as a legible organizer: the fountain, planting edges, and paving patterns produce stable signs of 'center' and 'pause' that can be read quickly even during movement.

At the fountain edge, tactile and auditory emphasis can be interpreted as an affordance-rich boundary object. The stone rim affords resting the hand, leaning, sitting, and momentary contact with cool surfaces; water sound provides an acoustic anchor that remains stable across household variations. Semiotic meaning is strengthened because the fountain is both functional and emblematic; it materializes domestic care, cooling, and hospitality through a visible and audible element placed at the spatial core.

At the liwan (open space) seating zone, visual and tactile emphasis aligns with a typological vantage condition. Phenomenologically, the liwan (open space) supports a sustained, comfortable gaze back into the courtyard while remaining shaded; bodily comfort and social visibility coincide. Affordances include sitting, observing, and hosting, reinforced by raised benches and spatial framing. Semiotic cues arise from elevation, alignment, and the framed view that signals the liwan (open space) as a recognized social stage within the domestic setting. Table 4 consolidates these recurrent spatial moments and interprets them through phenomenology, affordance theory, and spatial semiotics.

Table 4. Interpretation of recurrent spatial moments through phenomenology, affordance theory, and spatial semiotics.

Recurrent Spatial Moment in the Entrance–Courtyard–Fountain–Liwan (Open Space) Sequence	Sensory Evidence from Participant Maps (What Repeats Across Cases)	Phenomenological Reading (Lived Experience)	Affordance Reading (Action Invitations)	Semiotic Reading (Material and Spatial Meaning Cues)
Entrance threshold and corridor (compression before courtyard release)	Early activation of auditory and smell traces before full courtyard entry; reduced visual depth followed by sudden opening	Bodily anticipation and recalibration as the house transitions from street to interior; the shift from narrow/dim to open/light becomes a memorable experiential event	Narrow geometry and turning discourage lingering and afford directed movement; controlled sightlines afford privacy while guiding progression	Boundary cue that signifies passage from public realm to domestic order; the change in acoustic character functions as a legible sign of interiority
Courtyard center (orientation and gathering)	Convergence of multiple senses around the courtyard core; repeated clustering near the central node	Release and openness support bodily reorientation; light and temperature shifts reinforce the sense of arrival	Clear centrality affords circulation, pausing, and face-to-face interaction; spatial openness affords social gathering	Fountain and paving patterns act as stable signs of “center” and “pause,” quickly readable during movement
Fountain edge (multisensory anchor)	Strong auditory presence and repeated tactile traces along the stone rim; visual clustering toward the fountain	Cooling, sound, and touch stabilize attention and produce a persistent sensory anchor	Stone rim affords leaning, resting the hand, sitting, and momentary contact; the edge affords lingering and social adjacency	The fountain operates as an emblematic domestic sign of care, cooling, and hospitality placed at the spatial core
Liwan (open space) seating zone (vantage and hosting)	Repeated visual axes toward the courtyard and tactile emphasis on raised benches and seating surfaces	Shaded comfort supports sustained gaze and social presence; bodily comfort and visibility align	Elevation and seating afford observing, hosting, and staying; spatial framing affords “stage-like” social interaction	Elevation and framed view function as signs of hierarchy and social recognition within the domestic setting
Kitchen–courtyard transition (food-linked gustatory traces)	Red traces originate at kitchen thresholds and extend toward courtyard gathering areas	Food-linked-related experience is tied to routine, anticipation, and memory connected to eating and serving practices	Thresholds afford serving movement and circulation from preparation to shared zones	Food-linked cues operate as domestic signs of shared life and sociability, reinforcing the courtyard as a communal core

Although cross-case regularities are strong, competing interpretations remain plausible. First, familiarity and routine may shape what participants mark as ‘dominant’ because residents repeatedly traverse the same sequence; the maps may therefore reflect practiced attention rather than purely sensory intensity. Second, transient conditions can affect smell and sound, including cooking activity, flowering cycles, wind direction, and time of day; these can amplify or dampen olfactory and acoustic cues without changing the underlying spatial sequence. Third, the mapping task itself may bias results toward easily verbalized or socially shared cues (such as the fountain) while under-representing subtle or private sensations. These limitations do not negate the recurring sequence, but they define the boundary of interpretation: the results support a typology-linked experiential pathway, while intensity and olfactory spread may fluctuate with context.

Figure 10 presents the developed comprehensive sensory map of the traditional Damascene courtyard house, illustrating the strong association between spatial sequence and sensory perception. The map begins at the entrance, specifically along the corridor separating the exterior from the interior courtyard. This transitional zone engages hearing and smell. Typically shaded and dimly lit, it restricts direct interaction with the courtyard while allowing the sound of the fountain to reach visitors as an initial auditory cue. The auditory stimulus in this area results from the sound of water flowing from the fountain and traveling through the corridor.

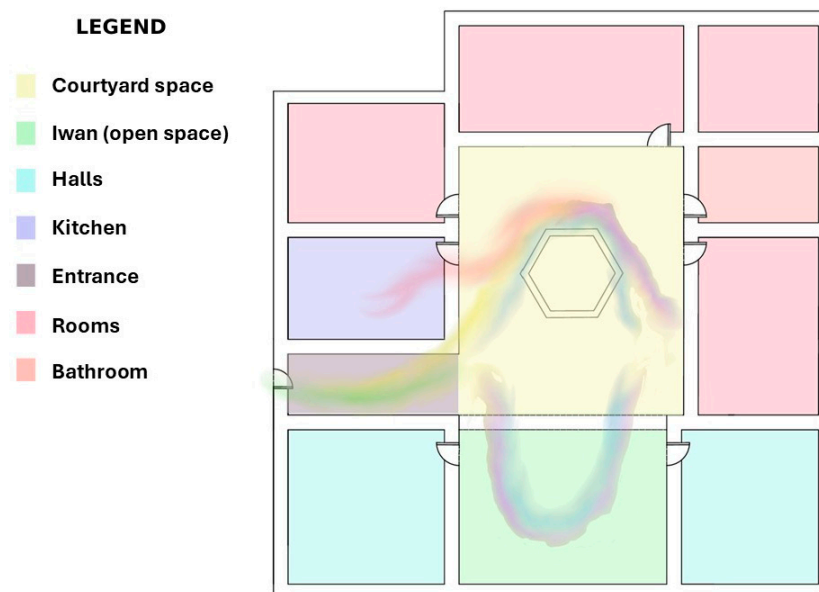


Figure 10. Developed comprehensive sensory map of Damascene courtyard houses. Colored lines represent different types of sensory perception: Yellow—Auditory, Green—Smell, Blue—Visual, Purple—Haptic, Red—Taste.

In the context of smell, environmental conditions and wind direction significantly influence the experience. When the door opens, the airflow carries the scents of the courtyard's plants and flowers, particularly jasmine and citrus trees, toward the entrance, establishing a sensory link between outdoors and indoors. This aromatic sequence intensifies the sensory engagement during the passage into the house. Hearing continues to draw attention toward the fountain, which functions as the primary source of sound and acts as a key courtyard feature. Touch and sight converge at two major architectural components: the fountain and the liwan (open space). The fountain plays a central role in both tactile and visual engagement, as it occupies the middle of the layout, around which the remaining architectural elements are structured. This positioning creates a sensory focal point that naturally attracts both touch and sight. In contrast, the liwan (open space), raised in elevation and designed with an open layout that provides a complete view of the courtyard, holds substantial relevance for these senses. Food-linked is mainly linked to the kitchen and continues into the courtyard space near the fountain, especially in the section closest to the kitchen. This sensory path positions the kitchen as the origin of food-linked-related activity, reflecting the process of food preparation. It extends toward the area by the fountain, indicating the movement from preparation to dining. This sequence highlights the courtyard's dual function, where both culinary tasks and social interaction take place as part of a shared sensory environment.

6. Conclusions

This study aimed to develop a structured methodology that integrates phenomenological observation with affordance theory and sensory semiotics to map moment-to-moment sensory activations in traditional Damascene courtyard houses. It addresses a critical gap in architectural research, namely, the absence of a guiding theoretical model that relates spatial design to the dynamic, embodied experience of multiple senses, whereas prior work typically isolated one or two sensory domains or treated courtyard houses solely as climatic or formal objects.

- Participants followed a remarkably consistent sensory pathway, moving from a narrow, sound-muffled entry corridor into the open courtyard, and converging at the cen-

tral fountain, demonstrating how sequential spatial arrangements inherently guide multisensory engagement.

- The central fountain emerged as a multisensory nexus: its flowing water anchors auditory attention, its stone rim invites tactile exploration, and its position frames key visual sightlines toward the liwan (open space).
- Raised benches in the liwan (open space) function as secondary tactile and visual nodes, offering vantage points where texture and form coalesce with shaded comfort, reinforcing the courtyard's social and architectural rhythm.
- Smell transitions unfold along planted borders and through shaded passages: jasmine and citrus scents drift into the threshold and intensify near the fountain, revealing how vegetation and microclimate collaborate to shape movement and memory.
- Gustatory markers trace a clear route from kitchen thresholds toward the fountain, suggesting that food preparation and communal gathering overlap spatially and sensorially, linking culinary activity with courtyard sociability.

Finally, the study recognizes certain limitations. For instance, the sample encompassed fourteen houses and two participants per case, which, although been forced due to the existing situation and war damage in Syria that limited the researchers' ability to find more cases, may not capture the full diversity of sensory responses or architectural variations.

Credibility was strengthened through within-house independent mapping by two residents under the same spatial layout, which enabled direct comparison of shared anchors versus individual variation, and through a transparent multi-level synthesis that preserves both convergence and divergence rather than averaging them away. Contextual factors observed during sessions, such as door state, ventilation, active cooking, or recently watered planting, were noted as qualifiers to avoid treating transient cues as fixed typological features. Future work can extend this approach through mixed methods that complement participant interpretation, including basic acoustic measurements near fountains and corridors, microclimate logging across courtyard and liwan (open space) zones, and structured odor sampling during different seasons, which would help validate the sensory attributions while keeping the mapping process grounded in lived experience.

Accordingly, future research can expand the participant pool through searching in similar contexts worldwide and possibly apply the discussed methodology to other architectural typologies and cultural contexts. Such steps would refine the theoretical framework and support conservation or design strategies that more fully respond to human perception.

Author Contributions: Conceptualization, R.S. and A.C.; methodology, R.S. and A.C.; writing—original draft preparation, R.S. and A.C.; writing—review and editing, R.S. and A.C. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: This study was reviewed and approved by the Architectural, Planning, and Design Ethics Sub-Committee at Eastern Mediterranean University with approval number 2024-03. The ethics committee reviewed the research and found it appropriate to proceed. Informed consent was obtained from all participants prior to their inclusion in the study.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper.

Appendix A. Participant Instruction Script Used During Sensory Mapping Sessions

Before each session, the researcher explained the task using a consistent script in everyday language. The participant was told that the activity documents how the house is sensed while moving through it, and that there are no correct or incorrect answers. The researcher introduced the plan as a simplified drawing of the participant's own house and pointed out the entrance corridor, courtyard, fountain, liwan (open space), and kitchen threshold. The participant was asked to walk through the house starting from the entrance and to draw the route on the plan while walking. Five colors were explained as five senses: blue for what is mainly seen, yellow for what is mainly heard, green for what is mainly smelled, purple for what is mainly touched, and red for taste or food-related moments. The participant was asked to choose only the dominant sense at each moment and to switch colors whenever the dominant sense changed. The researcher emphasized that the participant should mark what they personally experience rather than what they assume should be experienced, and that the participant could pause at any time to look around and then continue.

Appendix B. Sensory Mapping Field Protocol

1. Participants:
 - Number: 2 participants per household (total 28 participants across 14 homes).
 - Profile: Family members from different age groups or genders (e.g., parent and adult child).
 - Requirement: Long-term residents of the house.
2. Materials:
 - One simplified schematic base-map per household (hand-drawn by the researcher).

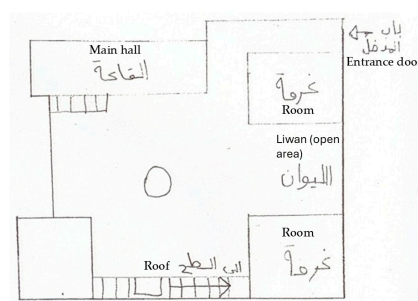


Figure A1. Sample schematic base map provided to participants prior to mapping.

- Five colored pens:
 - Red = Taste.
 - Green = Smell.
 - Yellow = Sight.
 - Blue = Hearing.
 - Purple = Touch.
3. Instructions (Delivered Orally Before Mapping):
 - You will walk through your home as usual, from entrance to courtyard, liwan, and other areas.
 - As you walk, use the colored pens to draw your path and mark the dominant sense you feel at each step.
 - Change pen color when your dominant sensory perception changes.

4. Timing:
 - Duration per session: ~45 min to 1 h.
 - Timing: Between 10:00 a.m. and 1:00 p.m.
 - Season: Spring to early summer.
5. Environmental Considerations:
 - Efforts were made to maintain consistent environmental conditions across all cases.
6. Data Recording:
 - Participant maps were scanned after each session.
 - Researcher also drew independent base plan for each home based on on-site observation.
 - These maps were used in further digital analysis (AutoCAD, PowerPoint, Photoshop).

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