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Understanding Urban Green Spaces through Lenses of Sensory Experience: **A Case Study of Neighborhood Parks in Dhaka City.**

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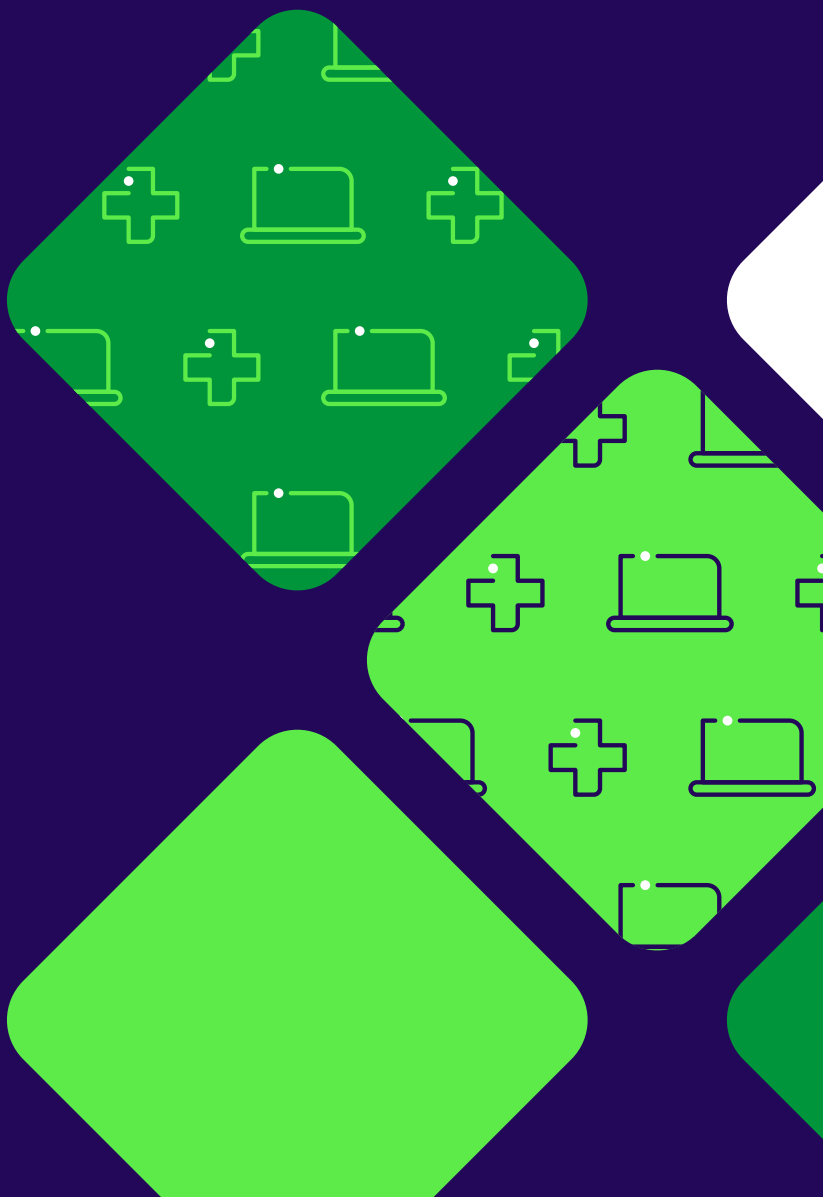

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Abstract

Physical, psychological, and emotional stress are common in today's Dhaka city, which can be intense or sensory excruciating. Urban green space is considered a healthy environment for mental repair and well-being in urban domains. The senses (vision, touch, sound, smell, and taste) are essential in interpreting space and experiencing the place and city. As a result, the sensory experience is a multimodal awareness of the environment that can impact users' health, pleasure, and emotions. The purpose of this paper is to explore the importance and role of sensory experience in planning and designing healthier neighborhood parks. This paper describes the research phases that aim to document, analyze, and visualize the multisensory qualities of neighborhood parks. It outlines the methods and findings of the study conducted in two parks in Dhaka city's distinct neighborhoods at different times of the day and week to record users' activity patterns and sensory experiences. Justice Shahabuddin Park in Gulshan 2 and Tajmahal Road Park, Mohammadpur, was chosen as the study locations to be investigated. The analysis comprised a combination of qualitative and quantitative methodologies, such as ethnographic research and on-site observation, geographical mapping, surveys, and walk-along interviews to capture subjective and objective sensory data and daily rhythms of neighborhood park users. The results suggest that all senses are essential in building healthy, inclusive urban green spaces.

Keywords | Environment, multisensorial experience, neighborhood parks, perception, urban green space, well-being.

1. Introduction

Rapid urbanization has been a leading cause of physical, mental, and emotional stress over the past forty years in the cities; therefore, it has aggravated interest in studying environments on health and well-being. Architects, biologists, and psychologists have pursued research to understand the impact of urbanization and environmental quality on stress recovery and well-being in earlier stages. Our overall sense of physical, mental, and social well-being is exceedingly shaped by the exchange of various stimuli in urban settings. Physical environments should provide a balanced and moderate degree of positive stimuli to enrich well-being positively (Berlyne, 1971). Citizens of Dhaka often face stress as the city fails to provide balanced positive stimulation. The city is either sensory overwhelming or sensory deprivation, which deteriorates the perpetual sphere. Consequently, urban green spaces are evident for health-supportive neighborhood design to embrace multisensory qualities strategically became crucial.

In order to perceive everyday spaces and experience a place and the city, the senses (vision, touch, sound, smell, and taste) play an essential role. Therefore, multimodal environmental awareness is a sensory-based experience that directly and indirectly impacts the users' health, electric pleasure, and good mood. To ameliorate positive mental health, sensory parks with emphasis on colour, texture, fragrance, texture, natural form, and seasonal interest in an urban setting are important (Ellis, 2011). It also helps to alleviate numerous health issues caused by the chronic stress of the users. Due to structural integrity and multifunctionality, urban green spaces (parks and gardens, forests and fields) and blue spaces (rivers, lakes, and ponds) help repair mental issues and well-being; however, they are an essential element of urban life; they are seen as a healthy landscape.

The experiences and well-being of users are highly influenced by components such as senses and emotions. The five senses affect a person's experience in neighborhood parks as they are a vital part of perception. For instance, 'visual' cues help to create an image of space in an area, 'sound and touch' clues help to provide identity and territory to space, 'taste' helps to interpret spaces, and 'smell' helps to recall memories about the place. As a product of something different and unique, blends of sights, sounds, smells, textures, tastes, and thermal conditions, the ambiance of urban spaces is created and experienced that resonates with our individual and collective memory (Thibaud, 2011). As a result, sensory experience plays a crucial role in placemaking, that not only helps to strengthen bonds between people and improves mental health and well-being.

There can be positive and negative characteristic features in the studies of the sensory experience of urban green spaces. The senses which enhance place identity, comfort, and perception of place, fall under the category of positive features. On the other hand, noise, odor pollution, placelessness, and lack of belongingness are negative features (Wankhede and Wahurwagh, 2017). These features affect the quality of

urban green spaces tremendously. In particular, both hazardous chemicals of foul odor and the smell of fruits and flowers in the park can be explored in the studies of smell scape. Similarly, soundscape studies can explore sound pollution and unique sound experiences such as birds chirping, water flowing in the park, and the wind flow. The success in designing urban green spaces and enhancing the quality of neighborhood parks depends on positive and negative sensory experience features.

Through the lens of a multisensory perspective, the work presented in the paper aims to manifest the sense and determinants to portray the role of sensory experience in the green spaces of Dhaka.

2. Research Scope and Objectives

The role of sensory experience in planning and designing a healthier neighborhood park discussion is the comprehensive aim of the paper. The main objectives of this research are as follows:

- To comprehend the neighborhood parks through the lens of its users.
- To encapsulate quantitative and qualitative, objective and subjective, multi-sensory data and daily rhythms of urban green environments of the users through analysis and visualization.
- To find the relation between senses, urban green spaces, and well-being.
- To address spatial elements, including its multidimensional and sensory experiences in planning and designing neighborhood parks, is helpful for researchers, planners, policymakers, and designers.

3. Literature Review

Senses and sensescapes, multi-sensory experience, and neighborhood park design

Understanding senses and urban sensescapes. Senses that allow oneself to navigate the world are the action of eyes, ears, nose, mouth, and skin, which are very intimate and personal experiences. At the same time, governed by social and cultural contexts, copious amounts of sight, smell, and sounds are public phenomena known as sensing. Henri Lefebvre, a sociologist, claimed that to govern a place in the city and declare it homely, humans use five senses (seeing, hearing, touching, smelling, and tasting) which are the fundamental anthropological components of social needs ingrained in urban society.

New landscapes, birds chirping, being touched by sunlight, and various types of smells of flowers and fruits, are examples of sensory stimuli that one counters as one visits a neighborhood park. One of the essential focal points is the sensory captivating nature of urban green spaces to consider the consequence of senses on positive and memorable user experiences. To specify, the multisensory dimensions reflected by neighborhood parks can be analyzed and utilized in

urban planning and design as it is a positive stimulus for the users to experience and preserve the memory of a place. Recent research emphasizes the importance of understanding and identifying the sense scapes such as visual, auditory, tactile, olfactory, and gustatory senses rather than focusing entirely on the visual impressions of a place. These sensory experiences can be conducted with the five different systems; among them, visual and aural systems provide information over a wide range opposite to smell, touch, and taste receivers which receive information in a closer range (Bruce, Condie, Henshaw, and Payne 2015).

The study of senses in the urban landscape can be seen in viewscape, soundscape, touchscape, smellscape, and tastescape. The components and characteristics of urban sensescapes in the making of a place are as follows:

- Viewscape: It emphasizes the components like edge, pathway, nodes, landmarks, form, color, volume, size, diversity, imageability, and legibility.
- Soundscape: It focuses on characteristics like sound signal, sound types, and sound intensity.
- Touchscape: It consists of elements in terms of dryness, coldness, roughness, and hardness.
- Smellscape: It emphasizes the classification of smell as aromatic, fragrant, unpleasant, and nauseating.
- Tastescape: It consists of elements in terms of sweetness, sourness, saltiness, and bitterness of food.

Sensoryscape is the sensory experiences of the environment that reflects the idea of a sensorily constructed environment. Researchers have conducted multiple studies on the sensory experience of neighborhood parks based on the uniqueness, belongingness, structure, and sense of place that greatly depend on the identity and definition of a particular neighborhood park. With the help of sensory experiences (visual, hearing, smell, texture, and taste), the users predicate the degree of the neighborhood park experience either satisfactory or inadequate (Wankhede, and Wahurwagh, 2017)

Multisensory Experience. The five senses of human that helps experience the world are not isolated from one another. They collaborate to serve a complete and coherent realization of the environment. The denotation of multisensory experience is the contribution of perception with the help of more than one of the five senses.

Envisage taking entry to a neighborhood park where one can see trees, multiple shade structures, elements, and numerous amenities, pleasant smell conveyed from flower and fruit trees, where one can hear birds chirping, subtle sound of conversation and feel comfort from the seat and taking a walk on a textured walkway. The experience through the park is multisensory as it includes various perceptual experiences guided by different senses. The multisensory experience concept can be understood as experiencing one after another or having several different experiences simultaneously, or one unified experience as a repercussion of multiple unique experiences conveyed simultaneously (Auvrey and Spence, 2008). The paper intends to identify where these senses are solely co-occurrent from where they incorporate with each other or have a vivid influence on one another. The study aims to investigate the site's elements responsible for this distinctive sensory behavior.

Senses and enabling environments. The World Health Organization has highlighted stress as one of the major health challenges of the twenty-first century (Mazda, 2011). Living in a city can affect stress levels due to environmental factors such as high density, excessive stimuli, competition, and materialism. Multiple health issues such as cardiovascular disease, sleep disorder, anxiety, depression, and chronic diseases are exacerbated by prolonged exposure to urban stresses. Sudden nervousness and psychological and physical reactions to accumulated daily stress develop gradually.

A well-designed, aesthetically pleasing space and characteristics asserted to grasp attention, restrain stressful thoughts, activate positive emotion, magnify self-esteem and contribute to the sense of well-being for a very long time (Parker, 1990). However, studies have shown that exposure to nature than to urban environments can help recover from stress and be complete (Ulrich, 1991). Such exposure is a positive distraction and can have physiological benefits such as lower blood pressure and decreased the production of stress hormones. Additionally, it enhances positive emotions. The physical environment and various features of urban green parks provide opportunities for physical and social activities and various health benefits for people of all ages.

Immersed in the environment through the sensory experience (sight, hearing, smell, or touch) can have positive effects. Urbanities can have physical, mental, and social benefits by spending time outdoors. Studies claimed that a positive correspondence between every day productive and leisure activities in the park mitigate physical and mental health issues and diseases (Niti, Yap, Kua, Tan, and Ng, 2008).

Agreeing to Weden et al. (2008), neighborhood qualities are subjectively perceived by people depending on how they vehemently associate with the degree of self-related well-being. Architects and planners are opportune to contribute to individuals of all ages' physical and mental well-being through the essential thought of subjective recognition and sensory qualities of neighborhood parks.

4. Research Approach, Methodology, and Result

4.1 Research approach

Phenomenology is the study of perceiving the structure and interaction between all sensory domains (recognized by the eye, ear, nose, skin, and tongue) and consciousness experiences, which helps to express emotions and meaningful experiences of the urban environment (Merleau-Ponty, 2002). The study uses the phenomenological approach, which investigates the multisensory experience of Dhaka city neighborhood park users.

4.2 Methodology

The study intends to methodologically contemplate tangible sensory qualities of neighborhood park environments and subjective multi-sensory experiences. Through various outlooks and processes of captivation, measuring, assessing, analyzing, and visualization (Degen, 2008; Degen and Rose, 2012; Naghizade and Ostadi, 2014; Pink, 2008; Rogerson and Rice, 2009). The Sensory notation system developed by Lucas and Romice (2008) brought forth an instinctive, orderly, and comparable way to apprehend subjective multi-sensory responses. Based on socio-sensory discernment and an ethnographic approach, regarding Lefebvreâ€™s (2004) rhythm analysis, a multimodal mapping procedure for archiving sensory encounters was created by Palipane (2011).

The analysis comprises a combination of qualitative and quantitative methodologies, such as ethnographic research and on-site observation spatial mapping, surveys, and walk-along interviews, based on a comprehensive literature assessment of theories and research methods. The following research methods and results are discussed in this paper:

Visual Ethnography Exercises (first-person observation; participatory survey)

a. Photo Journeys: Two photo journeys through selected neighborhood parks were conducted by the participants (n=10), the first to capture the participants' first encounter with space and the second to document the sensory qualities of space and participants' subjective multisensory experiences. The first walk was undertaken in groups, with research participants lasting only 20 minutes. The three teams (3-4 members/team) were asked to be driven by the space in the park and take ten photos of whatever they wanted while carefully marking the path taken and the points where the photos were taken. This was followed by a group discussion lasting another 20 minutes to reflect on and verbally explain their experiences in three keywords of their choice. The second journey was more guided where the teams walked their respective same routes one more and captured another set of 10 photos for each route, followed by keywords. However, this time, the participants were asked to document focusing on their subjective sensory experience- positive and negative, identifying the intensity, level of comfort, or pleasure of experiencing specific sensory stimuli at particular spots.

Photo elicitation and focus group discussions from both walks were the primary methods used for data collection. The participants were asked to think about the following questions during the exercise:

- How sensory-rich is the site investigated site? What senses predominate? Were they able to capture all the senses? Are the sensations pleasant or unpleasant?
- Do views, sounds, textures, and smells impact participants' health and well-being?
- What aspects/elements of this site positively or negatively impact health and well-being?

b. Sensory Notation: The second section looked into Lucas and Romice's (2010) sensory notation charts' capacities to capture the same site's major sensory experiences systematically and comparably.

A sensory audit was carried out at the zones identified from photo walks. The use of the sensory notation system, however, helped to establish patterns, not based upon the value judgments of the space in a normative manner, but rather spaces which have qualities- distinctiveness where experienced with the full range of sensory apparatus: the thermal, tactile, kinetic, chemical, visual and aural. This system uses a radar chart diagram with six axes for each perceptual system- visual, kinetic, chemical, auditory, thermal, and

tactile systems.

At this stage of the investigation, the participants were instructed to walk the same route as previously selected and record the different sensory stimuli according to the conditions, purpose, and context at various zones in the park. The site was recorded in terms of the priority of the senses from a scale of six down to one, which helps to give a picture of the most effective sensations down to those which are least important and least effective.

Sensory & Activity Rhythm Analysis

On-site observations were conducted at the mentioned sites to document and analyze quantitative spatial-sensory data and usersâ€™ activity patterns. Observation points were selected based on an analysis of existing land use and available on-site amenities.

c. Quantitative Spatio-Sensory Data: The sources and intensity of various sensory clues (visual, aural, tactile, smell, taste) were documented using multifunctional environment meters to objectively record the sound level [dB], light [lux], humidity [%RH], air temperature [deg C], and airflow [km/hr.]. To identify the levels of intensity and comfort at each point of observation, such quantitative data were augmented with subjective information obtained by sensory scales, charts, or sliders (Malnar & Vodvarka, 2004). Measurements were performed every three to four hours to capture changes in sensory characteristics throughout the day.

d. Users' Activity Data: To observe and document transitory and stationary activities occurring in the sites, a 'snap-shot' method and 'tracing' were adopted from Gehl & Svarre (2013). The researchers counted the number of people passing by or doing stationary activities (e.g., seating, playing, exercising, etc.) at each observation point for a brief period (5-10mins). The users' age, gender, and ethnicity were also noted. The relationships between daily activities and sensory qualities were investigated further as a form of synthesis.

Socio-Perceptual Surveys through Questionnaires

Users' perceptions, satisfaction, and utilization of specific locations in their neighborhood parks were investigated through socio-perceptual surveys. A survey was taken of 120 people aged over 18 who visited the parks in the summer of 2022. Furthermore, the data collection was based on stratified probability sampling defined in space and time. The researcher divided the site into sub-zones to obtain a diverse sample in terms of places (the main places of interest that attract visitors) and various activities in the park (walking, jogging, playing, interacting, and sitting). In relation to the time, the researcher decided to apply questionnaires on different days during June and July at different times of the day.

Questions about the visitors themselves covered gender, age group, and ethnic group. Visit characteristics included frequency of visits, length of stay, the purpose of visit, and activities undertaken. Visitors were also asked to rate their sensory, walking, and overall experience during their visits to the park.

4.3 Selection of the Study Area.

With a few planned zones and others developing spontaneously and organically, the structure of Dhaka city has evolved in stages. Be that as it may, the entire metropolis is considered a densely built environment. A careful study was conducted in Dhaka to distinguish different neighborhood parks for assessing multi-sensory encounters with diverse spatial settings. Two parks in Dhaka city's distinct neighborhoods are studied at multiple times of the day and week to record users' activity patterns and sensory experiences. Justice Shahabuddin Park in Gulshan 2 and Tajmahal Road Park in Mohammadpur was the study locations for investigation.

4.4 Analysis and Findings of Case study

4.4.1 Justice Shahabuddin Ahmed Park, Gulshan 2

The park is 9.55acre in size and is located in the heart of the Gulshan 2 area. The park's east and west sides are surrounded by roads that provide easy accessibility to the site. Due to the diplomatic area location, the park is used by foreign officials and residents. The park is mainly covered with over 1500 trees of nearly 40 species, including fruit, flower, and medicinal trees. The park has separate lanes for jogging, walking, and cycling, which attract users of all ages to visit. Several modern facilities (gymnasium, mosque, library, watch tower, viewing deck, ghat, a separate space for women, basketball court, badminton court, an amphitheater for 300 people, and pond) attract many joggers and visitors to the park throughout the day.

Figure 1: Views of Justice Shahabuddin Ahmed Park, Gulshan

Location	Size and Shape	Physical features	Special features	Name of tree
Ward no: 19 Zone: 3 [North]	Size: 9.55 acre Shape: Square	Tree cover: Wide and medium Small canopy: 35% Shrub: 15% Grass: 55%	No. of tree: 1500 Tree cover: Wide and medium Canopy: 40%Small canopy:30%Shrub:20% Grass: 40%	Holy basil, Justicia Adhatoda, Neem, Gardenia Jasminoides, Garden Croton, Singapore Daisy, Jackfruit, Mango, Blackberry, Lichi, etc.

Table 1: Physical characteristics of Justice Shahabuddin Park, Gulshan

Visual Ethnography exercises- Sensing the site.

The initial research stage adopted a participatory research approach, involving the participants visiting Justice Shahabuddin Park and ethnography journey exercises and notations of sensory experience and body movement.

(a) Photo-Journeys- The teams' individual photos and sensory documentation (route 1, route 2, and route 3) from both walks were compiled and compared, as shown in Figure 2. Upon overlapping these maps, the repeating points of interest of the participants after two walks were identified (Figure 3). These spots were identified either by pleasant or unpleasant sensations experienced by the participants during the photo walks. The sensory responses at this stage helped to primarily locate the zones rich with sensory stimulus, namely, prayer areas including toilets, ghat areas, pond, watchtower, drinking water fountain, seating area or kiosk, amphitheater and stage, badminton court, ghat and viewing deck, women's shelter, and basketball court.

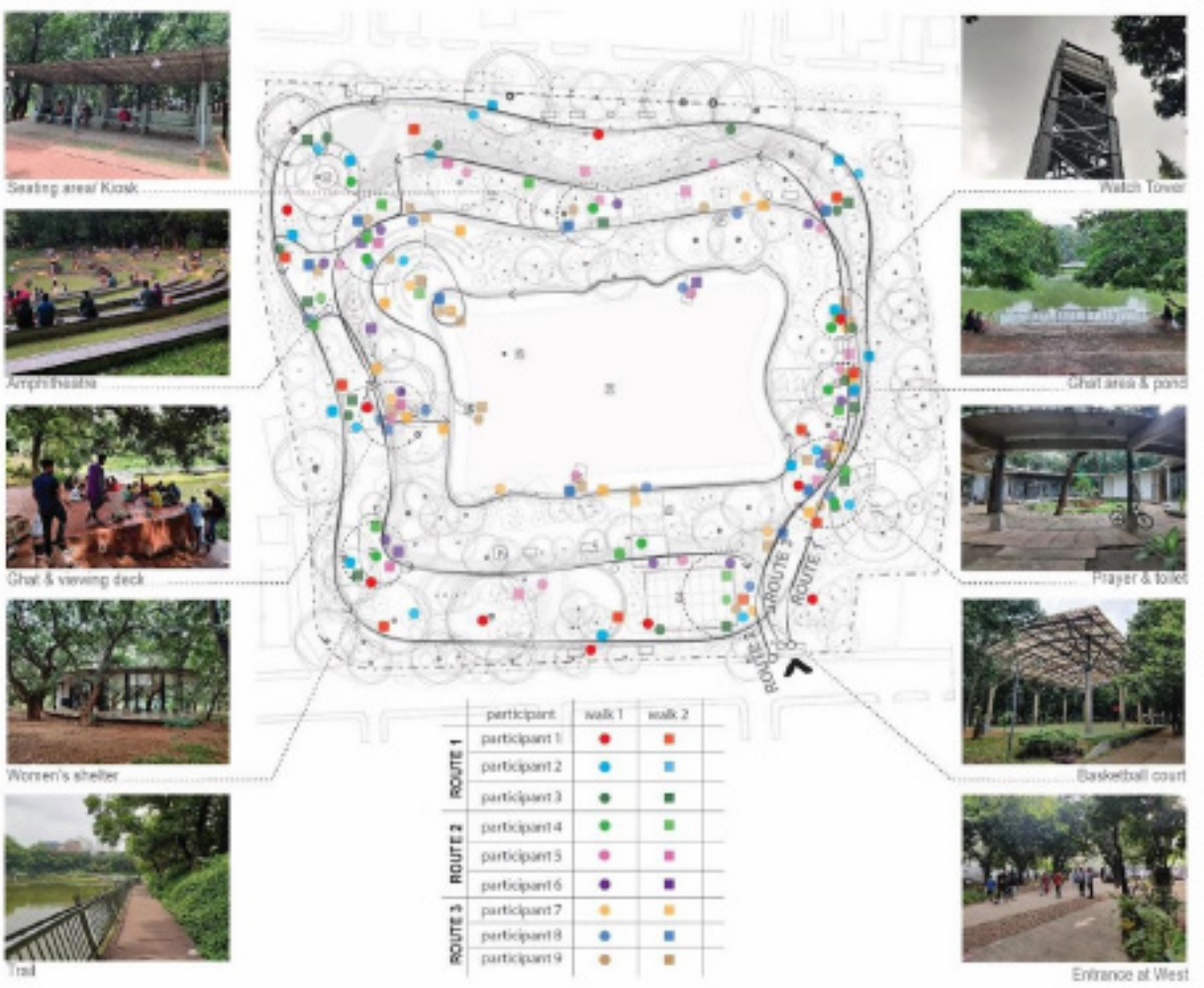
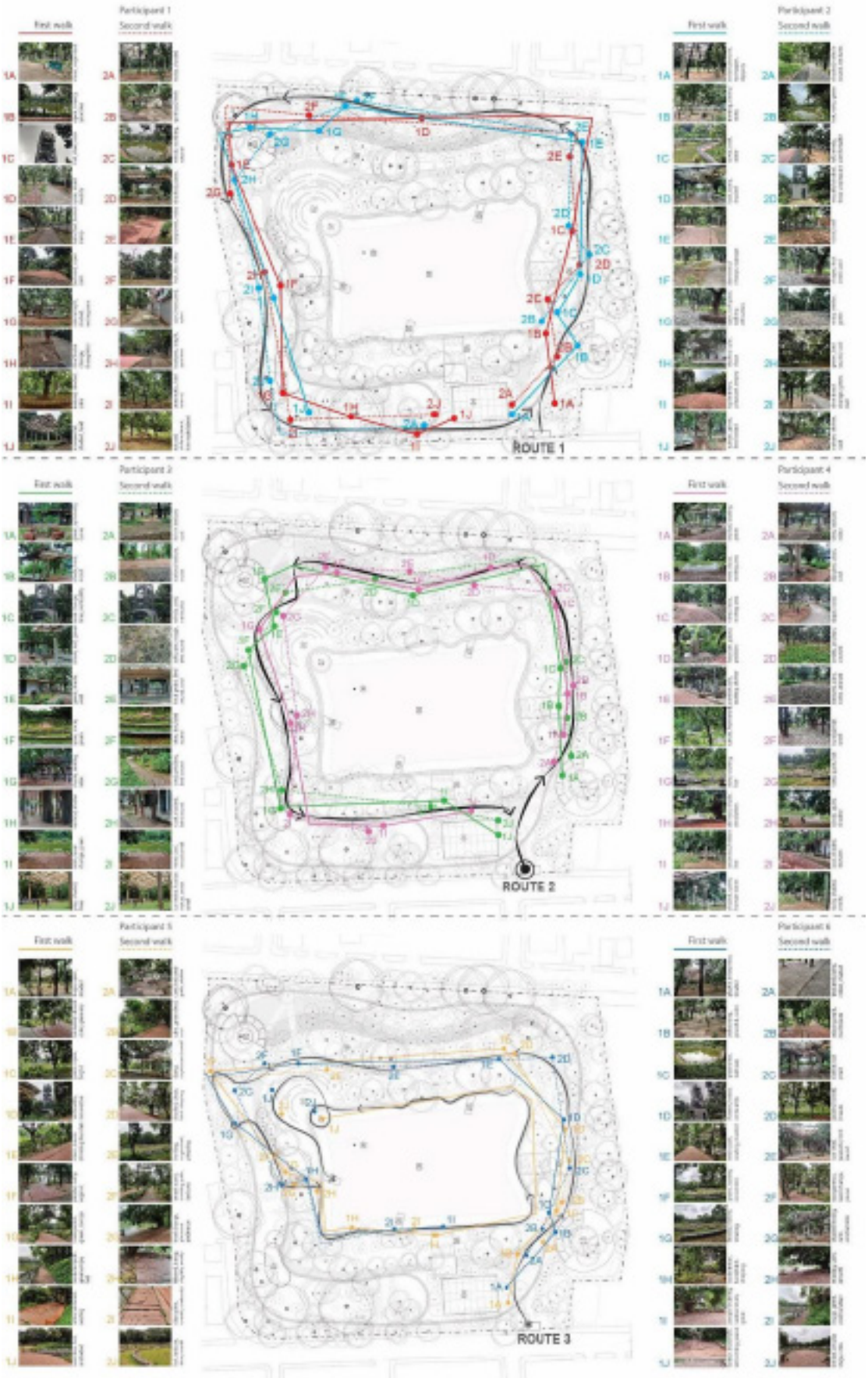
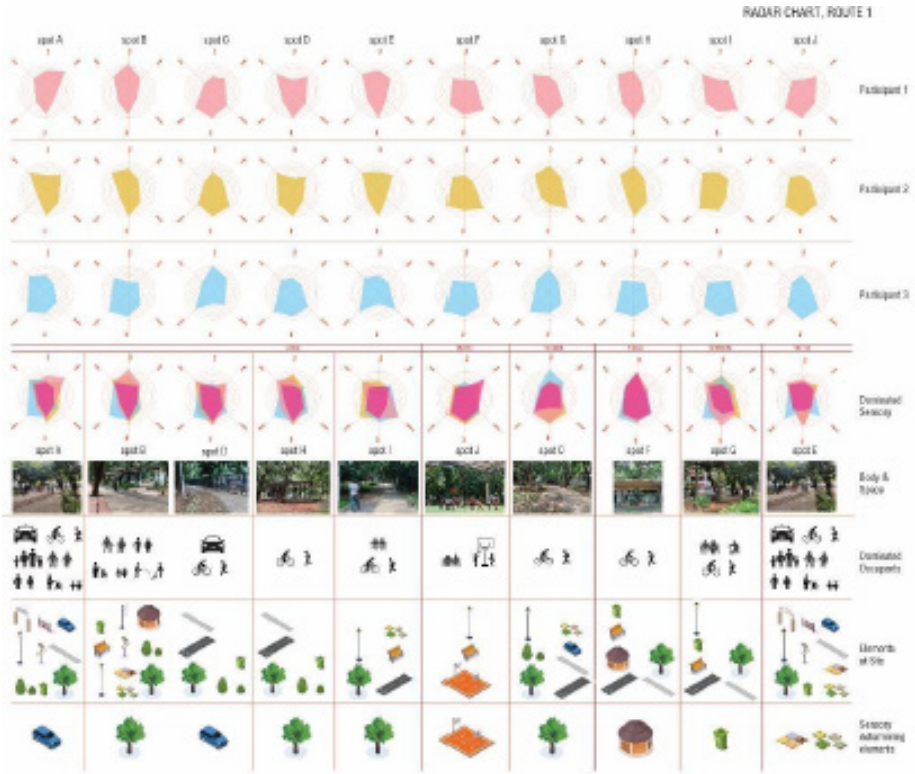
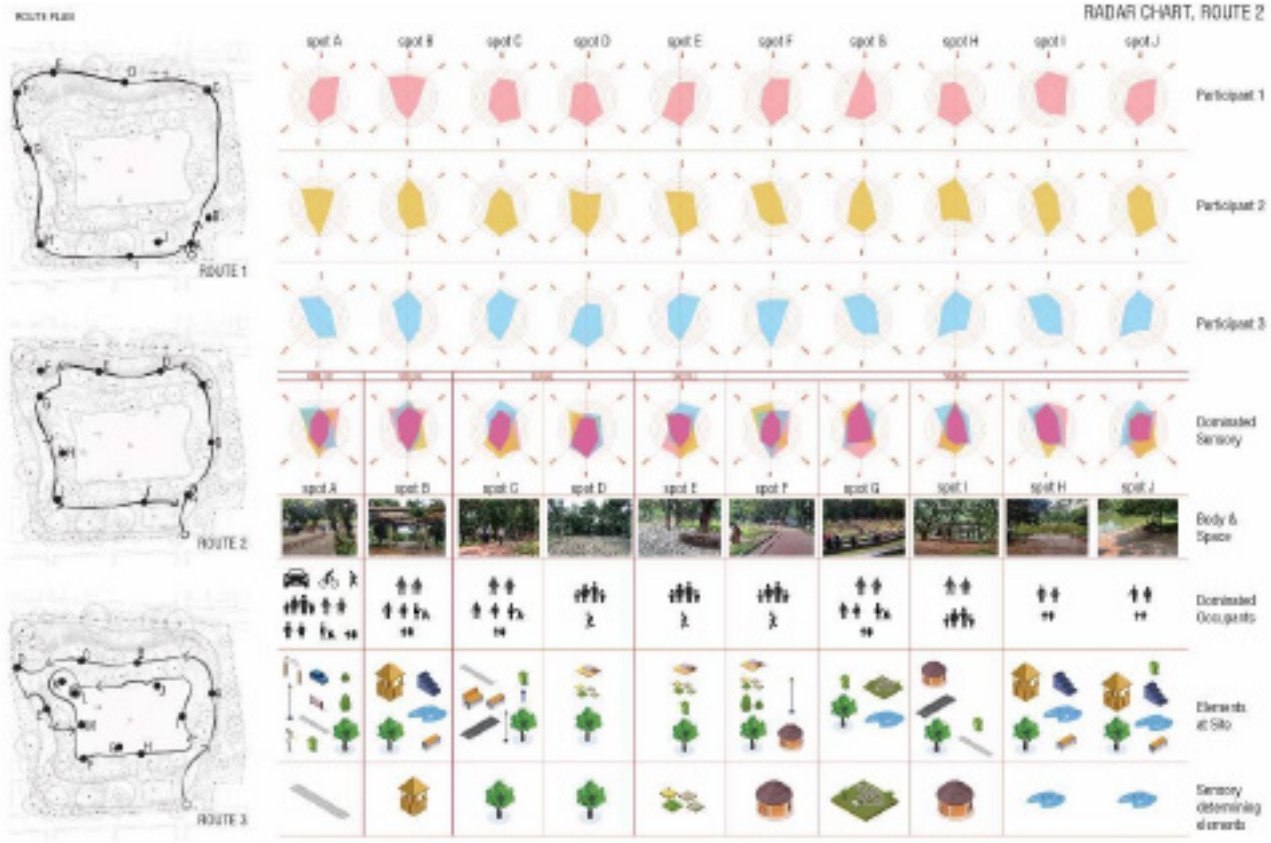


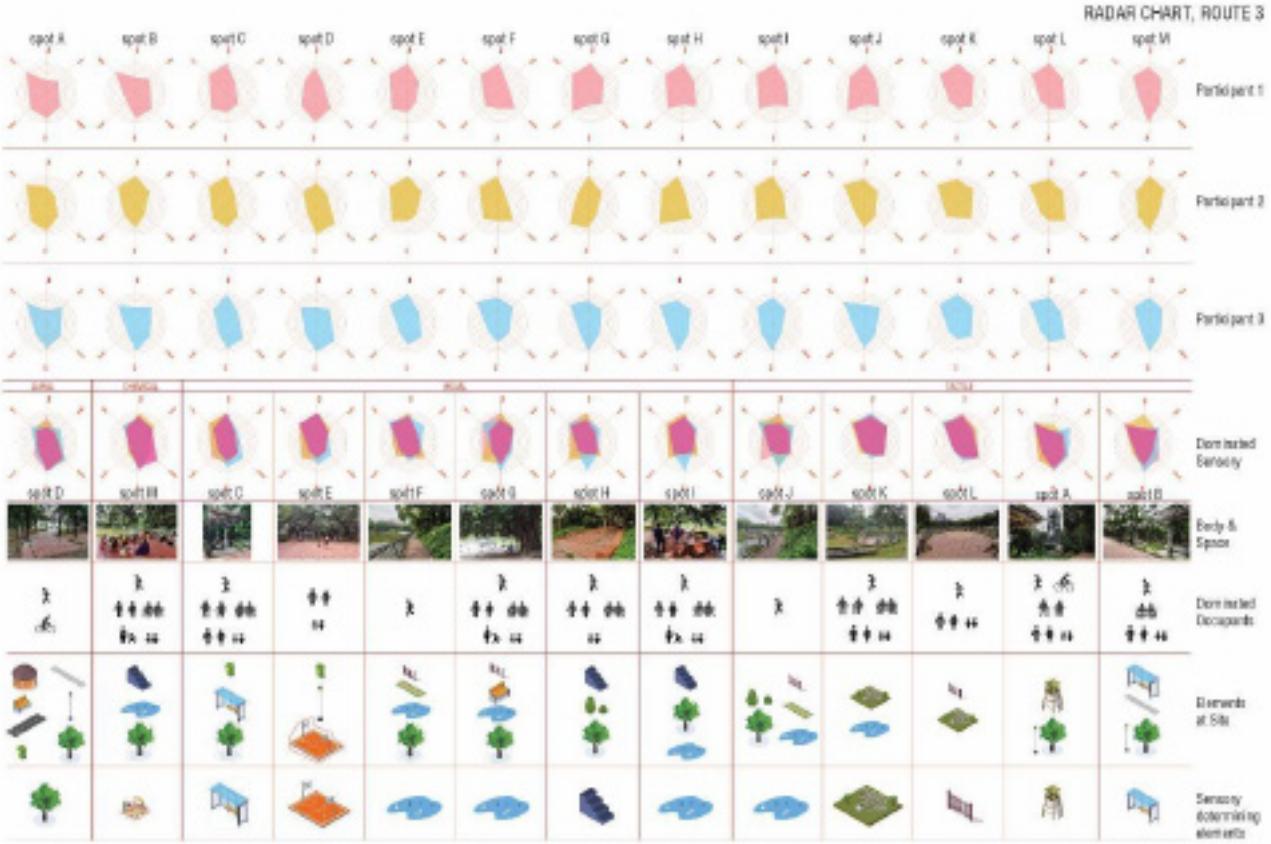
Figure 3: Identified points of interest of the participants from the two photo journeys of Justice Shahabuddin Park, Gulshan.


ROUTE 1
ROUTE 2
ROUTE 3

(b) Organizing perception- Sensory Notation. A series of sensory notations were recorded at the spots at three different routes, taking readings across the park, corners, in the middle, in quiet places, and busy flows of people, and presented in a Radar chart diagram (figure 4a, 4b). Each zone was recorded regarding the priority of the senses, understanding which sense was dominant and most important.
Layering a series of notations on top of one another generated a picture showing which senses are most vital in this park and which perceptual systems have been neglected. At this stage of the study, along with the dominant sensory experience (at each spot), dominant occupants, and sensory determining elements at the site were also identified (figure 4a, 4b). For example, the strongest perceptual system at spot A (route1) near the west entrance is identified as 'Aural' due to noises caused by the heavy movement of traffic on the adjacent road. Since the dominant occupants in this zone include cyclists, passersby, and joggers of all ages, we also observed a rise in the kinetic system in the radar chart. A moderate rise is observed in the tactile system due to various textured materials for the bicycle lane, running track, and walking lane. In spot J (basketball court), a sudden rise in the kinetic system is noticed in the radar system due to the high movement of players on the court. At this spot, the court is identified as the sensory determining element. At spot F, the building structure played an essential role in determining 'visual' as the dominant sensory among other elements in the site. In route1, most of the selected zones (zone A, zone B, zone D, zone H, and zone I have a more robust 'Aural' perceptual system as the route is located at the periphery of the park (figure 4a). Whereas zones (zone C, zone E, zone F, zone G, and zone H) in route 3 have a stronger 'Visual' perceptual system due to the presence of a pond, greenery, and amphitheater (Figure 4b).
The study at this stage helped to understand the reason behind the repetition of points of interest from the earlier photo walks the participants took. Most spots or zones are observed to be rich in sensory stimulus compared to the other zones in the park. The study also shows that the dominant sensory experience of the users is not only subjective but is also dependent on the dominant occupants and sensory elements (such as road, greenery, fruits or flowers, pond, textured pathways, seating, and building structures, present on site. The grouped notation allowed us to understand which park zones are sensory dominant, sensory overwhelming, and sensory deprived. Urban designers and architects can thus easily decide what needs to be screened or removed, what needs to be added, and what changes are appropriate to the neighborhood park design for the well-being of the users.




ROUTE PLAN
ROUTE 1
ROUTE 2
ROUTE 3
RADAR CHART, ROUTE 2
spot A
spot B
spot C
spot D
spot E
spot F
spot G
spot H
spot I
spot J
Participant 1
Participant 2
Participant 3
Dominated Sensory
Body & Space
Dominated Occupants
Elements at Site
Sensory determining elements


RADAR CHART, ROUTE 3
spot A
spot B
spot C
spot D
spot E
spot F
spot G
spot H
spot I
spot J
spot K
spot L
spot M
Participant 1
Participant 2
Participant 3
Dominated Sensory
Body & Space
Dominated Occupants
Elements at Site
Sensory determining elements

Sensory and Activity rhythm analysis

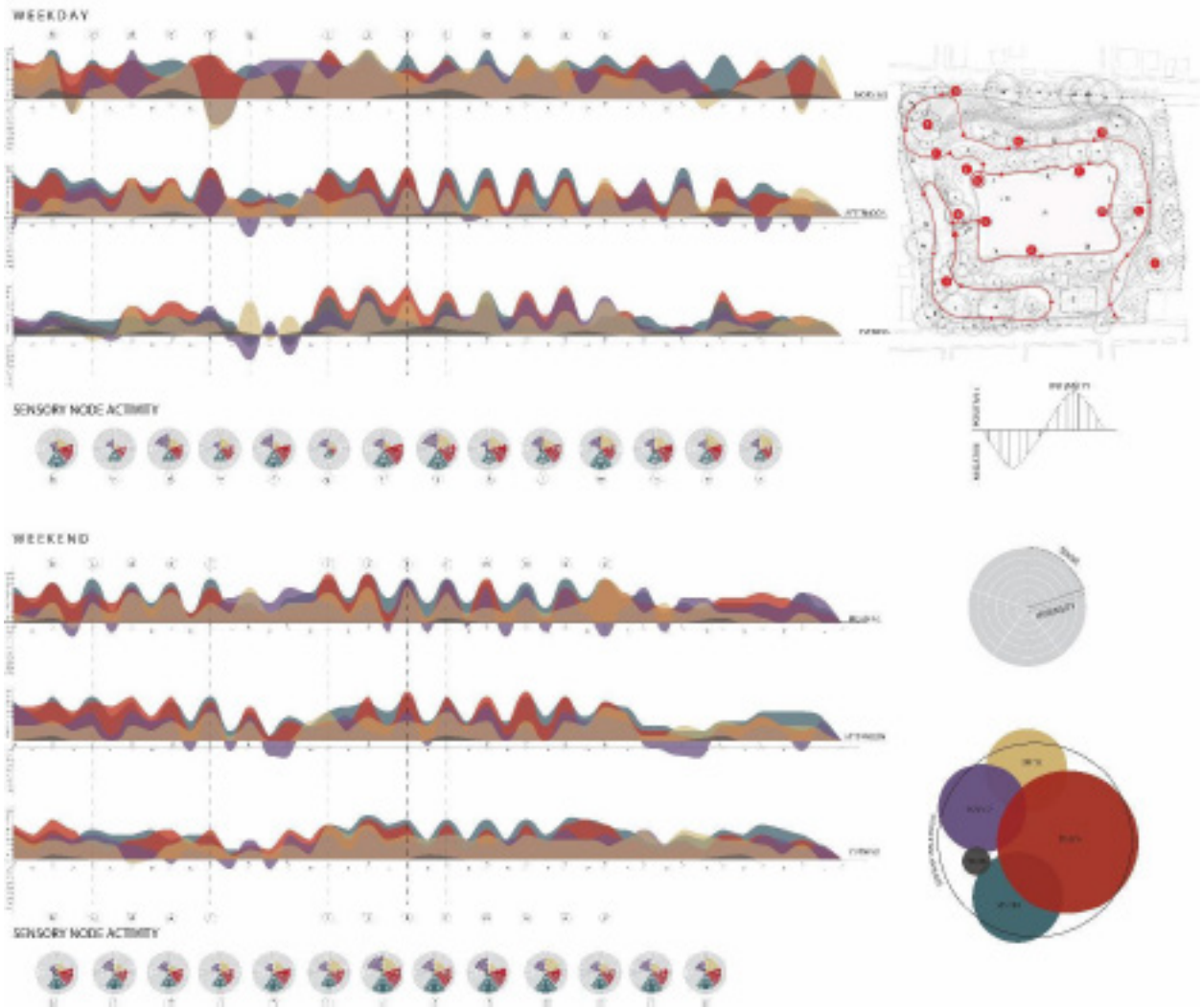
The observation was carried out at specific points based on the previous findings and amenities in the park, covering key spots of activities.

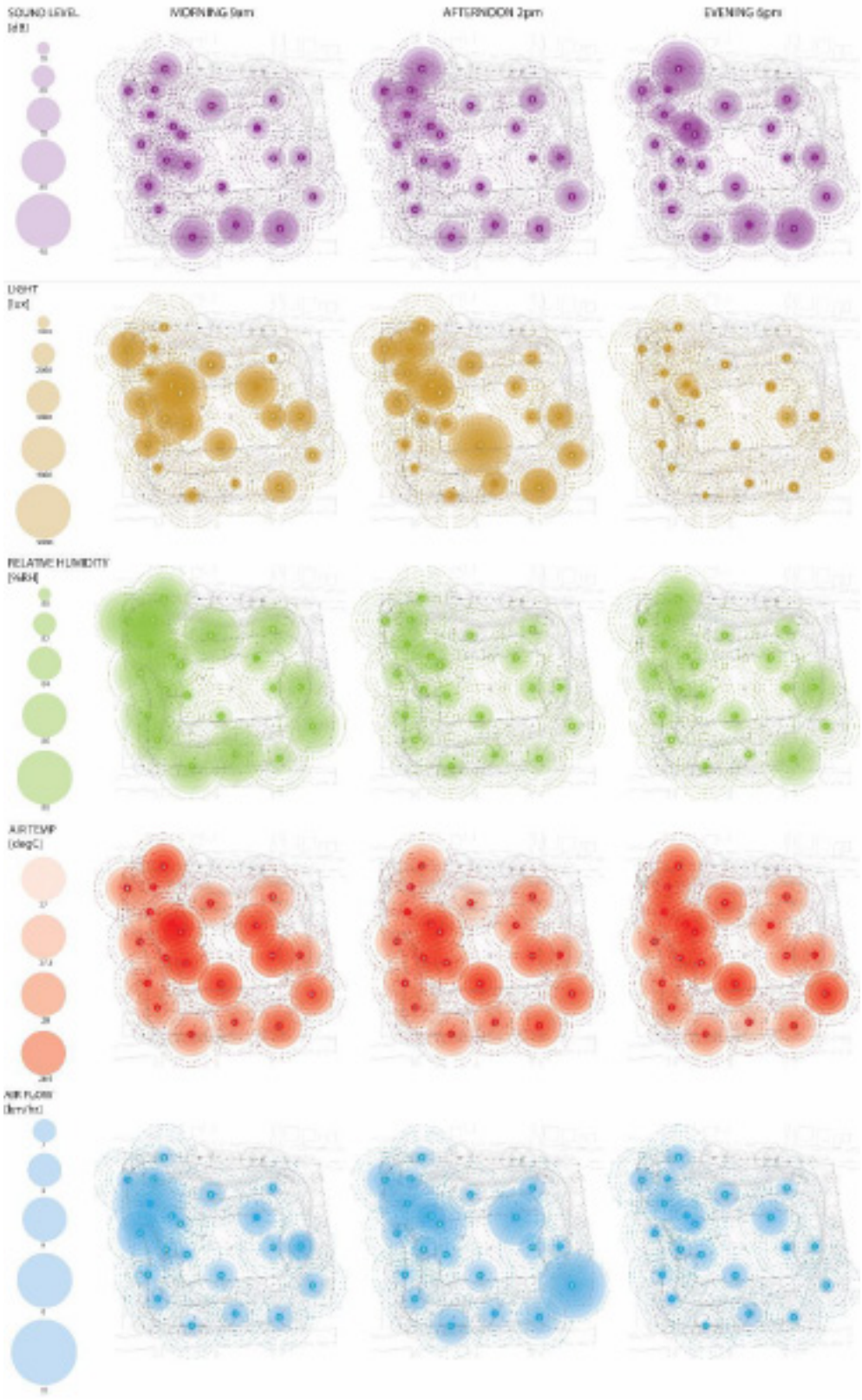
(c) Quantitative spatial-sensory data. The study area was taken under observation in the month of May-July in 2022. This period is characterized by hot and dry weather, has an average relative humidity of 80-90%, the air temperature ranges from a maximum of 33.1deg C to a minimum of 27.2deg C, and the airflow ranges from a maximum of 9.7km/hr. to a minimum of 0.3km/hr., the illuminance level ranges from a maximum of 3940lux to a minimum of 204lux, and the sound level ranges from a maximum of 78.7dB to a minimum of 51.0dB.
The instrument has taken all these data at 21 points to record objectively. The points are taken at 50 feet intervals throughout the site and measured at three different times of the day (figure 5a).

To identify the levels of intensity (positive or negative) and comfort of specific stimuli at each observation point, such quantitative data will be augmented with subjective information obtained by sensory scales (figure 5b). Measurements were performed at three different times of the day (weekday and weekend) to capture changes in sensory characteristics throughout the day.

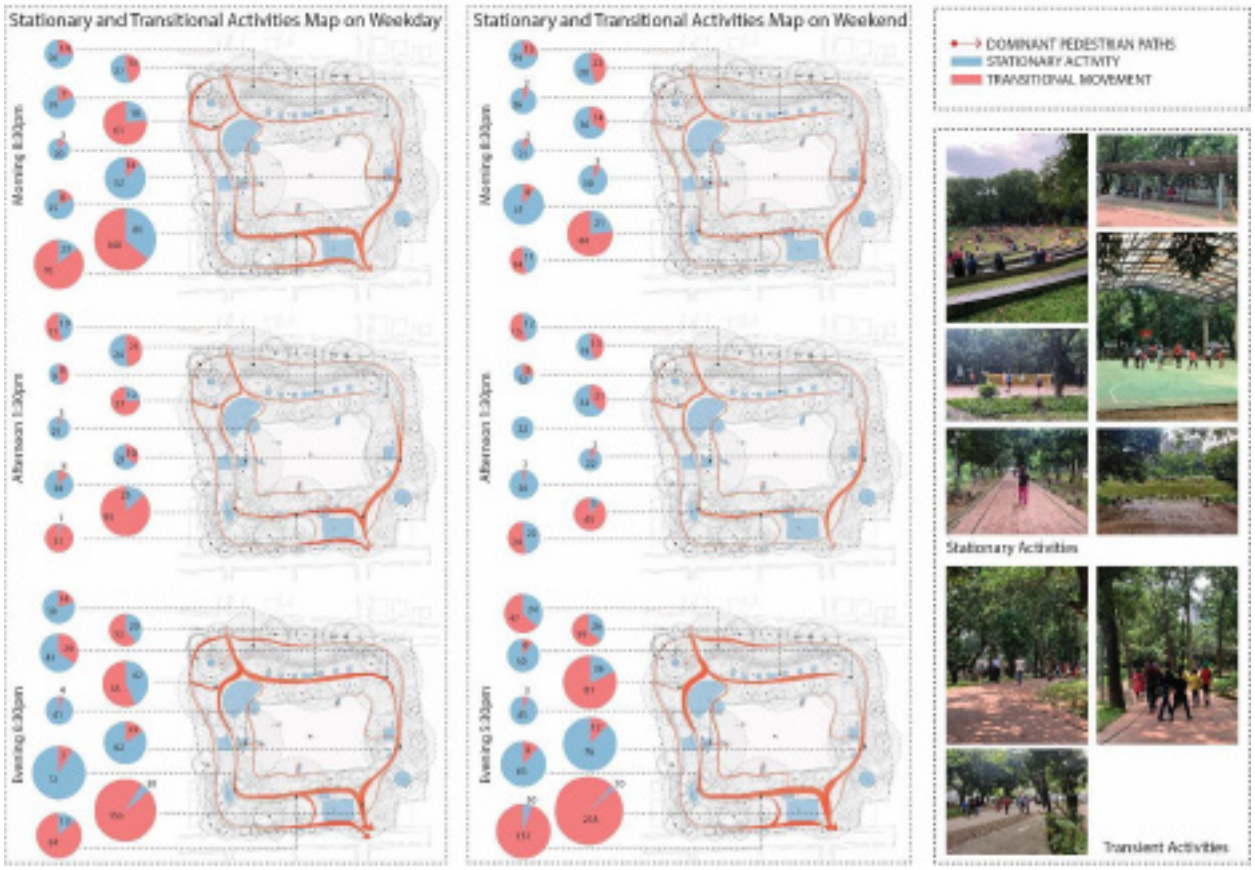
The intensity of sensory stimuli of the points b, d, f, i, j, k, l, m, n, o, and p remain at their peak throughout the day and week. These points are identified as active sensory nodes, namely:

- Prayer area (b),
- Seating area/ kiosk (d),
- Library area (f),
- Amphitheatre and stage (I, j, k),
- Ghat area at the south (m),
- Viewing deck at the west and north (n, o),
- Ghat area at the north (p)




SOUND LEVEL
MORNING 9am
AFTERNOON 2pm
EVENING 6pm
LIGHT
RELATIVE HUMIDITY
AIR TEMP
(degC)
AIR FLOW

(d) User's activity data- Apart from users' activity patterns, the activity mapping (figure 5c) also represents the pedestrian movement pattern that shows where people go and which trails people mostly choose. On further analysis, the relationships between daily activities and sensory qualities of particular spots in the park were found to overlap. The dominant pedestrian pathways are primarily located near the active sensory nodes. These pathways have way finders, signage, textured material, and proper shading. Upon analyzing pedestrian activity patterns, it has been observed that stationary activities (such as seating, playing, and exercising) mainly occur at the sensory activity nodes identified earlier. Findings show that spots the most frequently occupied by the park users are the prayer area, seating area, amphitheater, ghat areas, and basketball court, which are also the sensory richest places in the park (figure 5c).



Socio-perceptual surveys

A total of 122 users in Shahabuddin park participated in the surveys, 67% of whom were male and included people from various ages and backgrounds. Since the park is located in the diplomatic area, users of different ethnicity were observed using the park daily (Table 2).

Age	Valid Sample	%
Under 18	6	5%
18-24	34	28%
25-34	38	31%
35-44	26	21%
45-54	8	7%
55-64	6	5%
65 or older	4	3%
Total	122	100%

Gender	Valid Sample	%
Male	82	67%
Female	40	33%
Total	122	100%
ETHNICITY	**Valid Sample**	
Bangladeshi	108	
Australian	2	
Russian	2	
Cantonese	2	
Indian	4	
Korean	4	

Table 2: Survey participantâ€™s profile- Justice Shahabuddin Park, Gulshan.

Leisure and park activity- The majority, 36% of the users, reported that they visit the park a few times every week and 3% only more than three times (figure 6), mainly engaged in jogging, walking, running or exercise, relaxing, cycling, playing and meeting friends (figure 7).

Figure 6: How often do you visit your neighborhood park?

Source: Survey data

Statement	Strongly Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Strongly Disagree
This neighborhood park is overall aesthetically appealing.	1.5%	1.5%	1.5%	28%	67.5%
This neighborhood park offers a good variety of areas with different ambient.	0%	1.5%	1.5%	22%	75%
The park shows obvious signs and features pertinent to different cultures.	13%	23%	24.5%	15%	24.5%
This park is often too crowded.	39%	22%	16%	18%	5%
Spaces in the park are generally clean and tidy.	1.5%	5%	6.5%	18%	5%
I often find spaces in the park smelly.	67.5%	16%	6.5%	5%	5%
I often find spaces in the park quite noisy.	49%	24.5%	10%	15%	1.5%
I feel overwhelmed and inundated in this park on an everyday basis.	59%	15%	20%	6%	0%

Table 3: Do you agree with the following statements related to your sensory experience?

The most frequented zones used and liked daily are the prayer area, seating area, amphitheater, ghat areas, and basketball court. The most disliked areas in the park are those near the dustbins, the noisy peripheral zone (adjacent to the road), and pathways diversion. Concerning sensory experience, users mostly strongly agree that the park is aesthetically and visually pleasing and offers a variety of areas with different ambient (e.g., amphitheater and stage area, shaded seating, basketball court, ghat areas). The users find their park clean and not smelly. However, many users stated that their park is frequently overcrowded (in the morning and evening) and noisy (table 3).

Regarding their walking experience, the users prefer sheltered pathways surrounded by greenery but avoid dark and isolated places. Slippery paths, obstacles, and lack of companionship are among the critical barriers to an enjoyable walking experience (table 4).

Statement	Strongly Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Strongly Disagree
There are many obstacles to walking around in the park.	49%	10%	6%	20%	15%
The ground/floors in the park are slippery when it rains, and I feel unsafe.	23%	13%	15%	15%	34%
I hesitate to go to the park if there is no one accompanying me.	52%	18%	10%	10%	10%
Nature makes walking through this park more enjoyable.	1.5%	0%	5%	38%	55.5%
I avoid passing by rubbish, messy areas, and dark places.	8%	5%	11.5%	10%	65.5%
I always prefer walking on sheltered pathways.	20%	8%	15%	13%	44%

Table 4: Do you agree with the following statements related to your walking experience?

Overall, most users are satisfied with the amenities available in the park, including the opportunities for different generations to socialize. 65.5% of the users feel happy living near this neighborhood park and find their neighborhood well-designed for all ages (table 5).

Statement	Strongly Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Strongly Disagree
Amenities in this park are well provided.	1.5%	1.5%	8%	33%	56%
There are plenty of opportunities for different generations (e.g., children and elderly) to meet.	11.5%	15%	6.5%	23%	44%
This neighborhood park is overall well-designed for all ages.	6.5%	15%	6.5%	23%	49%
I feel happy living near this neighborhood park.	5%	1.5%	5%	23%	65.5%

Table 5: Do you agree with the following statements related to your overall experience in this neighborhood park?

These findings from the questionnaire survey confirmed some of the issues identified in the initial stages of this research.

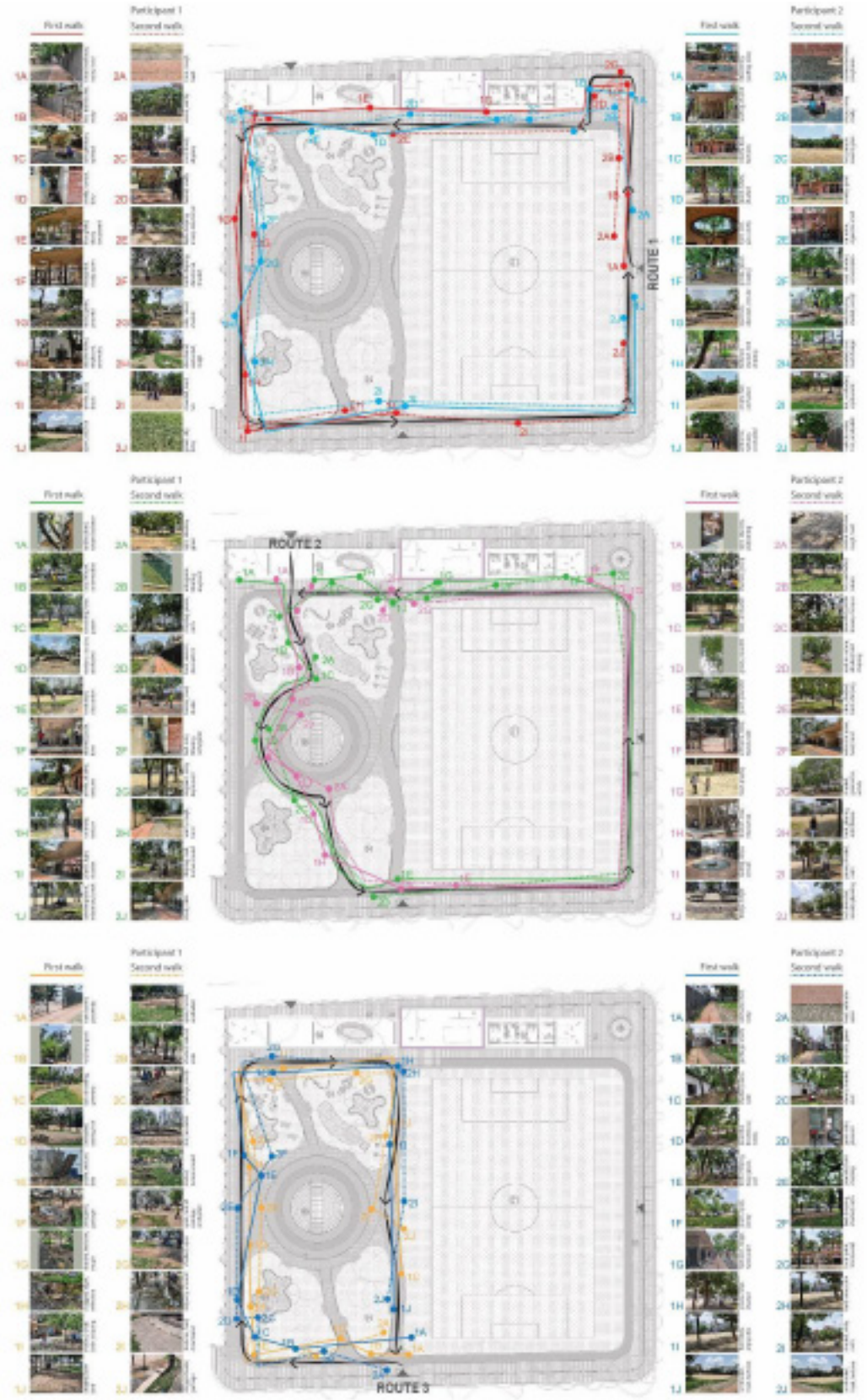
4.4.2 Tajmahal Road Park, Mohammadpur

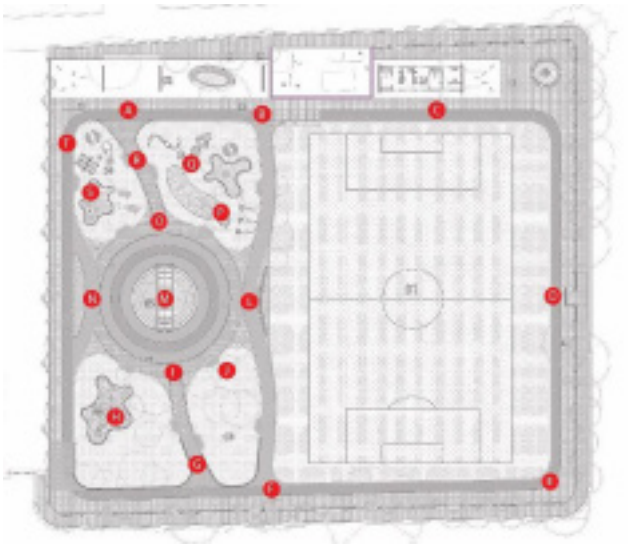
The park is 0.5acre in size and is located at Tajmahal Road, near Kisholoy School of Mohammadpur. Mohammadpur has been one of the planned residential areas of Dhaka since 1950, with roads of the regular grid pattern and mid-rise buildings. The park is surrounded by a mixture of uses ranging from institutional to residential. The park is between a playfield and mosque space and is widely used by the residents.

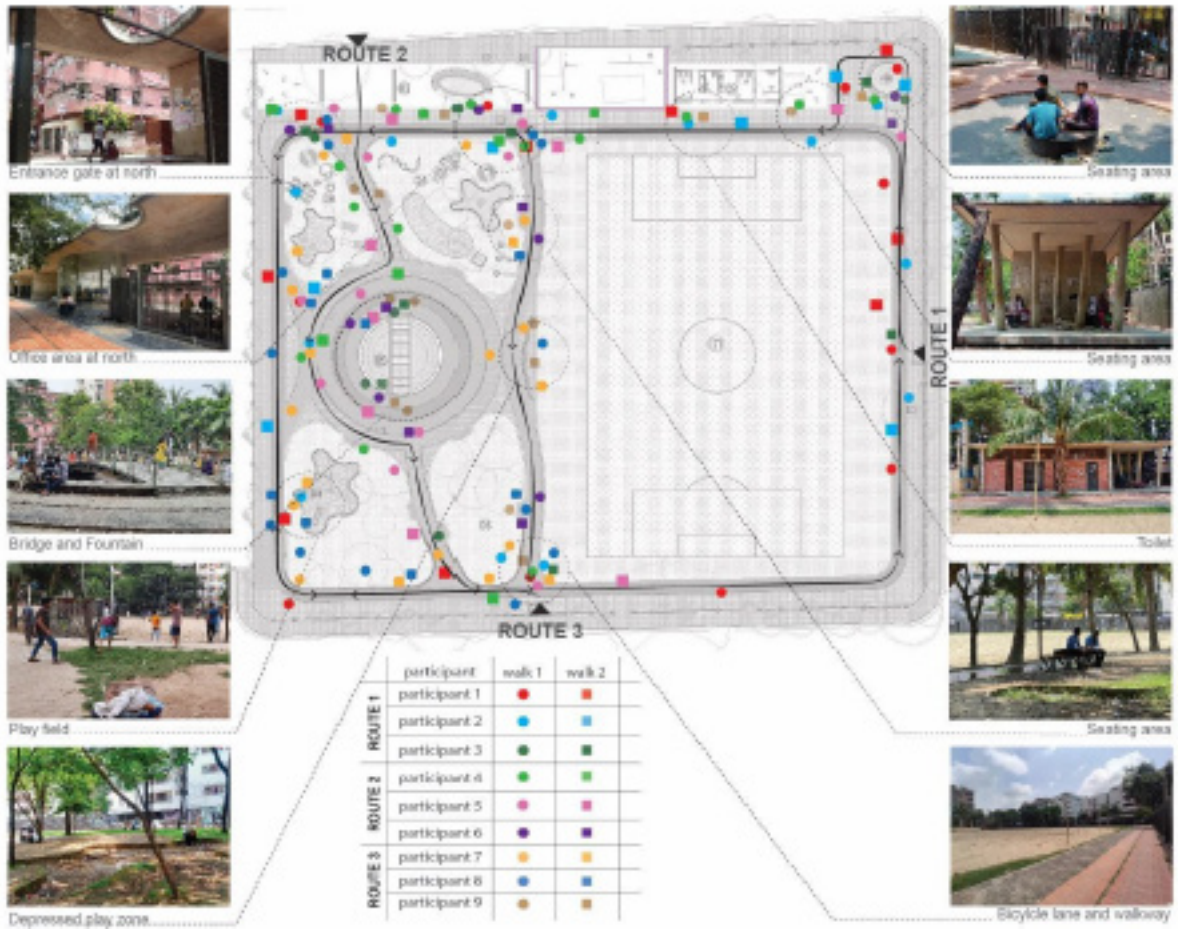
Figure 8: Views of Tajmahal Road Park, Mohammadpur

Location	Size and Shape	Physical features	Special features	Name of tree
Ward no: 29 Zone: 5 [North]	Size: 0.5 acre Shape: Rectangle	Tree cover: Wide and medium Small canopy: 35% Shrub: 15% Grass: 55%	Seating: 33 Monument: N Fountain: Y Amphitheater: N Play area: Y Exercise equipment: N Toilet: YPark shelter: Y Shaded walkway: N Prayer space: N Drinking fountain: N	Seating: 33 Monument: N Fountain: Y Amphitheater: N Play area: Y Exercise equipment: N Toilet: YPark shelter: Y Shaded walkway: N Prayer space: N Drinking fountain: N

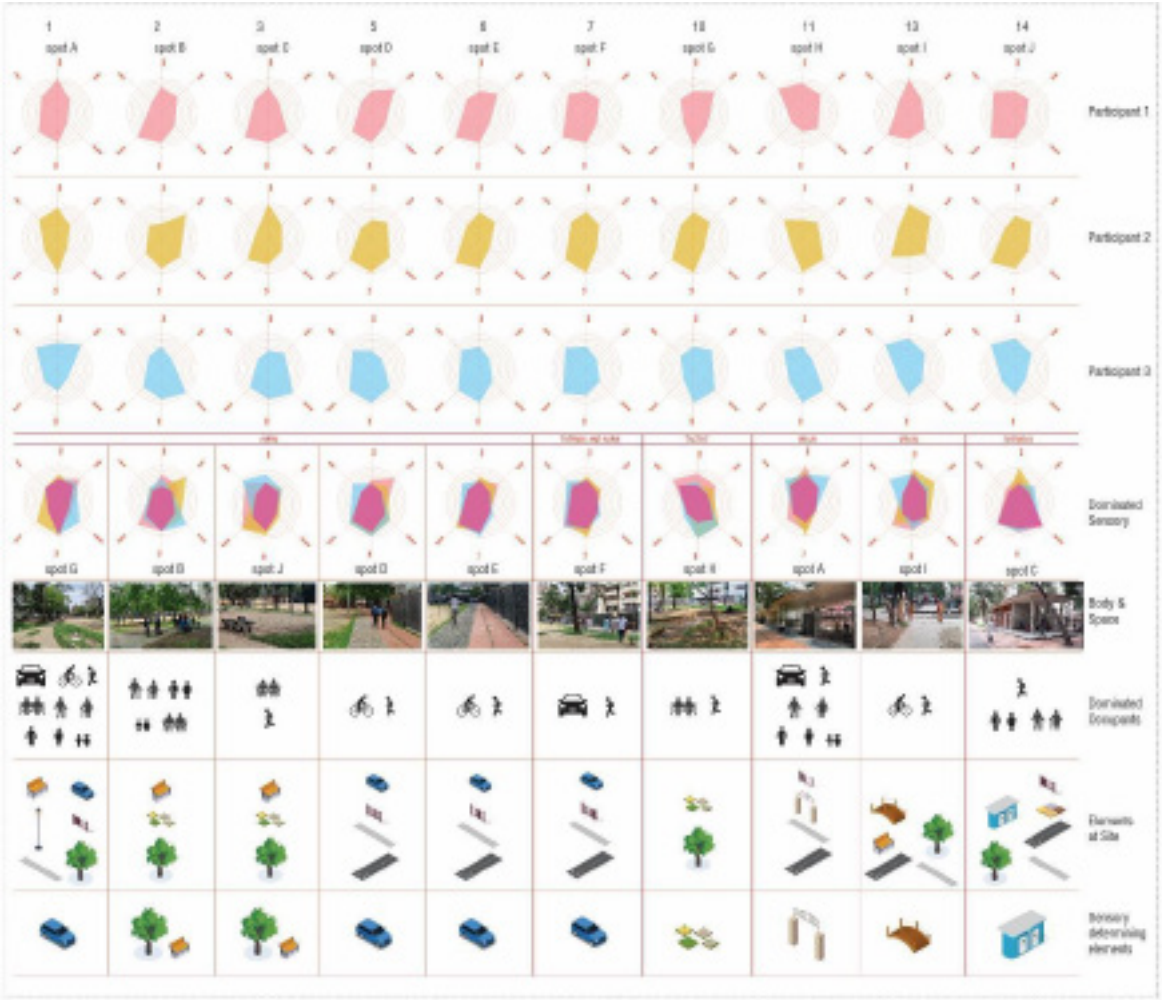
Table 6: Physical characteristics of Tajmahal Road Park, Mohammadpur.

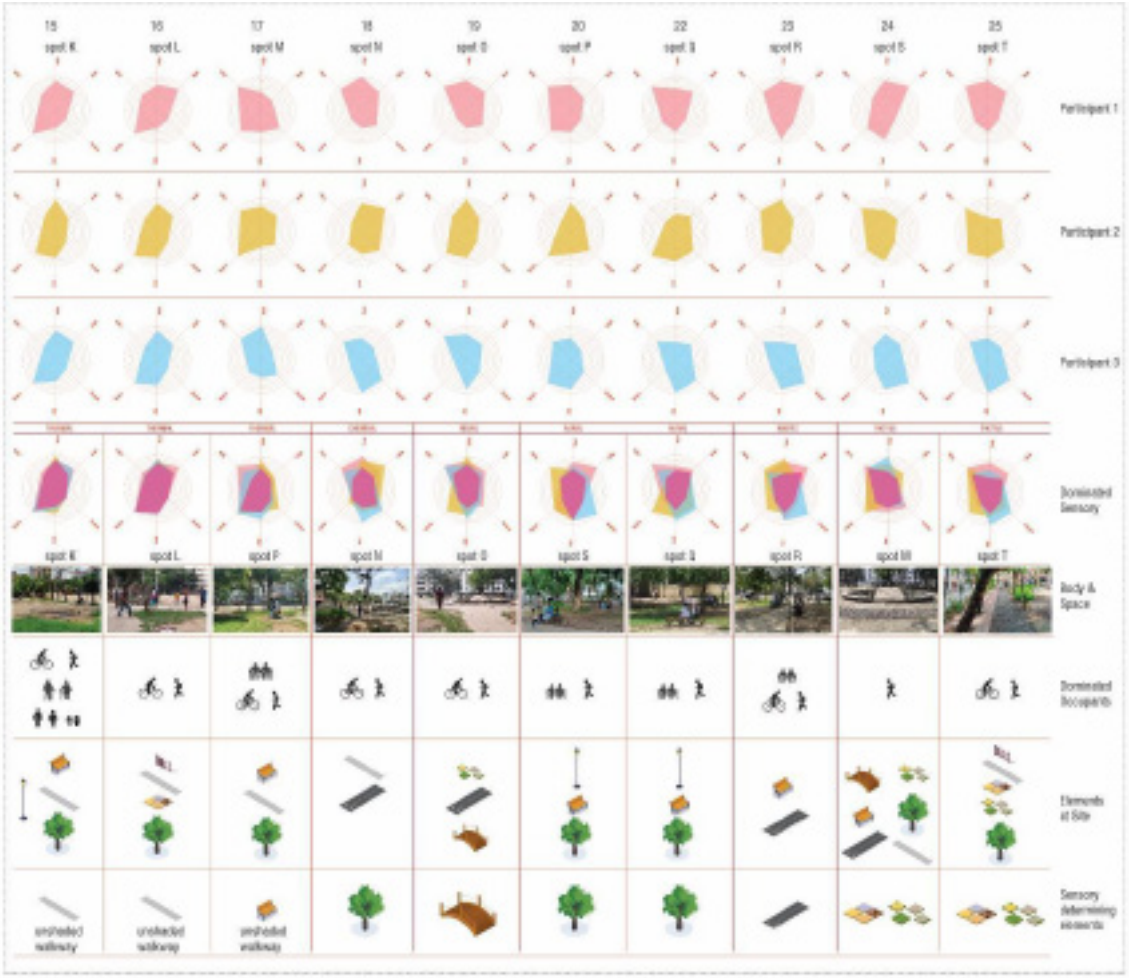

ROUTE 1
ROUTE 2
ROUTE 3




ROUTE 2
ROUTE 1
ROUTE 3
Entrance gate at north
Office area at north
Bridge and Fountain
Play field
Depressed play zone
Seating area
Seating area
Toilet
Seating area
Bicycle lane and walkway
participant
walk 1
walk 2
ROUTE 1
participant 1
participant 2
participant 3
ROUTE 2
participant 4
participant 5
participant 6
ROUTE 3
participant 7
participant 8
participant 9

(b) Organizing perception-Sensory Notation- A series of sensory notations were recorded at 20 spots (A-S) selected based on previous analysis, taking readings across the park, at the corners, in the middle, in quiet places, and busy flows of people (figure 11) and presented in a Radar chart diagram (figure 12a, 12b). Each zone was recorded regarding the priority of the senses, understanding which sense was dominant and most important.
Layering a series of notations on top of another generated a picture showing which senses are most vital in this park and which perceptual systems have been neglected. At this stage of the study, along with the dominant sensory experience (at each spot), dominant occupants and sensory determining elements at the site were also identified (figure 12a, 12b). It has been observed that the park is dominated by the aural perceptual system caused by various positive and negative sounds, such as traffic, birds chirping, and human. Apart from aural, thermal was observed to be the secondary perceptual system caused by adverse air temperature and lack of tree shades at various spots in the park, such as spot K, spot L, spot P, and spot F (figure 12a, 12b). At the same time, various tactile experiences at numerous spots in the park were also noted due to the presence of different textures such as paved walking trails, the wooden bridge, and sunken play zones.





Sensory and Activity Rhythm Analysis

(c) Quantitative spatial-sensory data The study area was observed from May to July 2022. This period is characterized by hot and dry weather, has an average relative humidity of 51.4-79.0%, the air temperature ranges from a maximum of 34.9deg C to a minimum of 29.6deg C, and the airflow ranges from a maximum of 5.0km/hr. to a minimum of 0.7km/hr., the illuminance level ranges from a maximum of 10,550lux to a minimum of 1,015lux, and the sound level ranges from a maximum of 73.9dB to a minimum of 60.4dB.

To objectively record, the instrument has taken all these data at 20 points (figure 11). The points are taken at 25 feet intervals throughout the site and measured at three different times of the day (figure 13a).

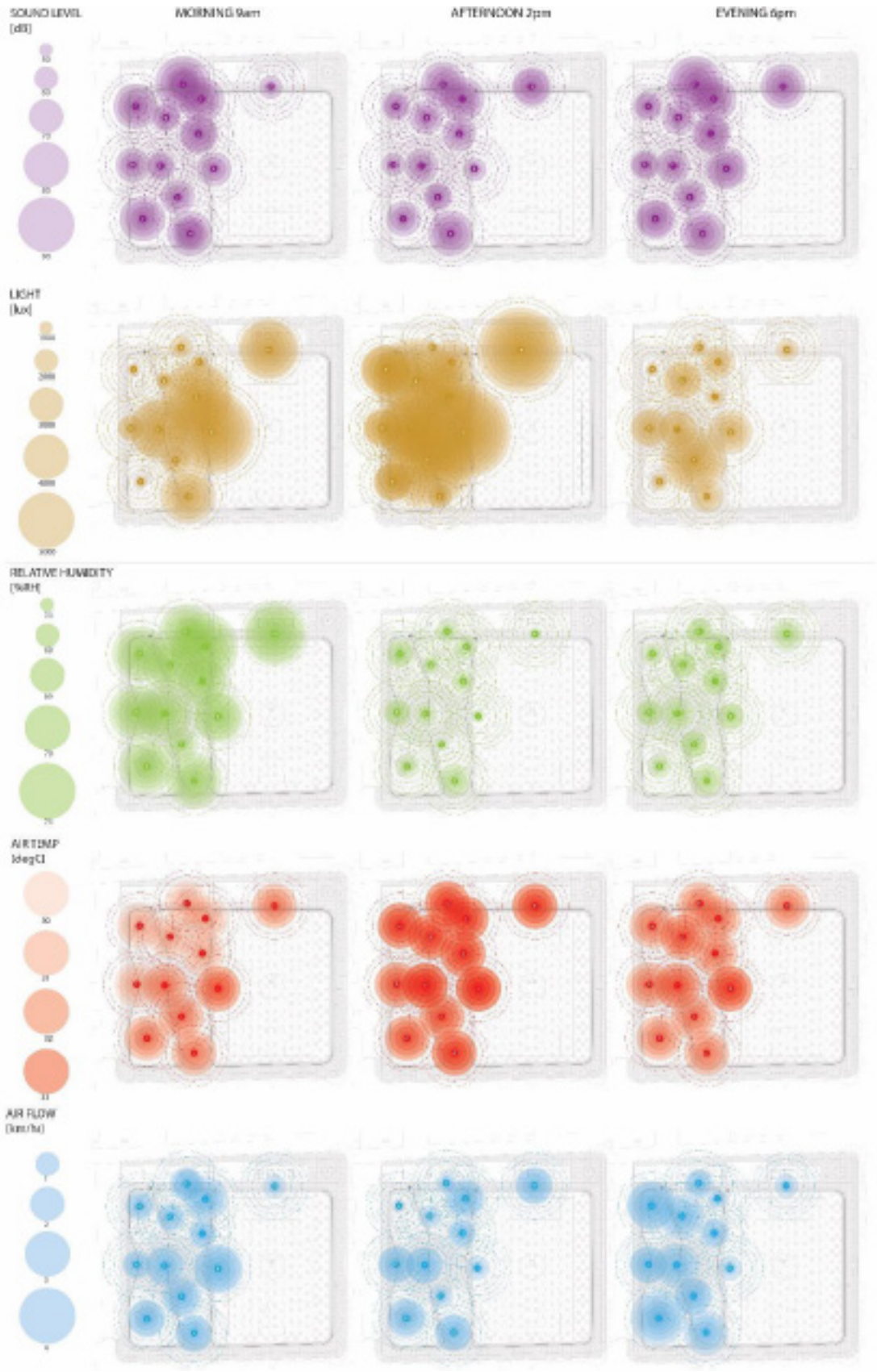
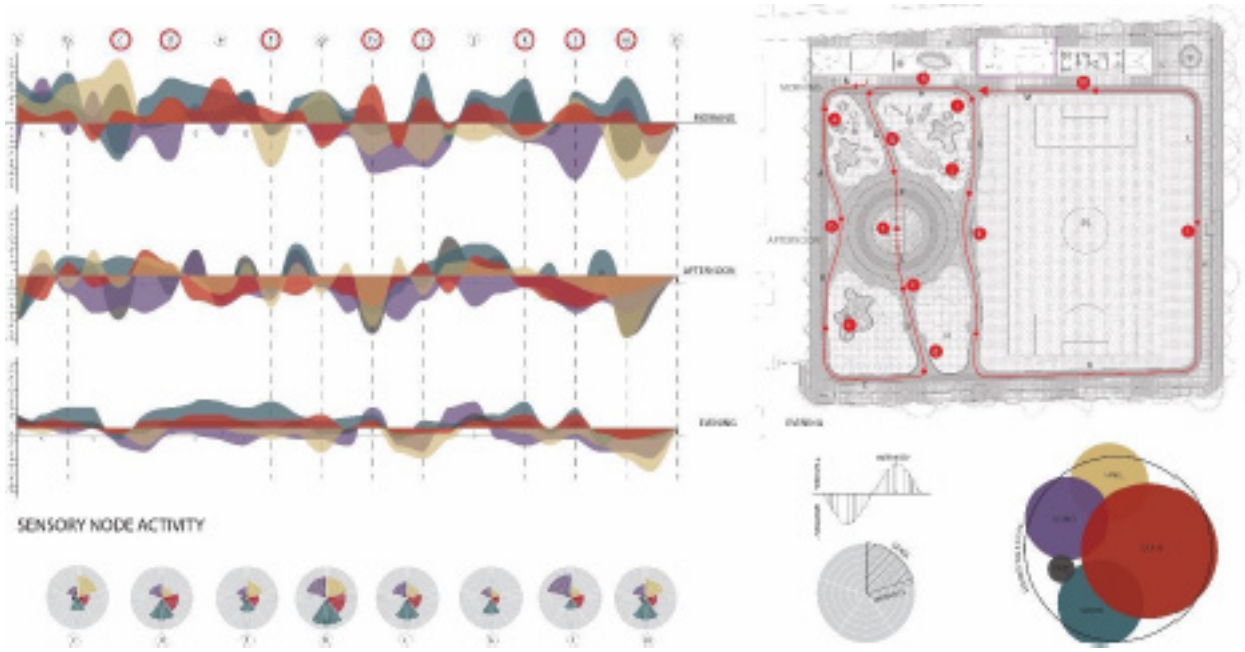


Figure 13a: Environmental data of Tajmahal Road Park, Mohammadpur.

To identify the levels of intensity (positive or negative) and comfort of specific stimuli at each point of observation, such quantitative data was augmented with subjective information obtained by sensory scales (figure 13b). Measurements were performed at three different times of the day (weekday and weekend) to capture changes in sensory characteristics throughout the day.

The intensity of sensory stimuli of the points c, d, f, h, i, k, l, and m remain at a peak throughout the day and week. These points are identified as active sensory nodes, namely:

- Sunken play zone (c),
- Entrance at south and north (d, h),
- Bridge/ fountain (f),
- Toilet area (m),



(d) User's activity data. Apart from user's activity patterns, the activity mapping (figure 13c) also represents the pedestrian movement pattern that shows where people go and which trails people mostly choose. It has been observed that the dominant pedestrian pathways are primarily located near the active sensory nodes and remain unchanged throughout the day and week. These pathways have way finders, signage, textured material, and proper shading. On further analysis, the relationships between daily activities and sensory qualities of particular spots in the park were found to overlap. Upon analyzing pedestrian activity patterns, it has been observed that stationary activities (such as seating, playing, and exercising) mainly occur at the sensory activity nodes identified earlier. Findings show that spots the most frequently occupied by the park users are the seating areas shaded by trees, and the bridge or fountain, which are also the richest sensory places in the park. The occupancy is found highest during the evening with an intense activity pattern (figure 13c).

Figure 13c: Users' activity pattern mapping- Tajmahal Road Park, Mohammadpur.

Socio-perceptual Surveys

At this point, 60 users in the Tajmahal road park participated in the surveys, 63% of whom were male and included people of various ages and backgrounds (Table 7).

Age	Valid Sample	%
Under 18	8	7%
18-24	28	23%
25-34	16	13%
35-44	24	20%
45-54	28	23%
55-64	8	7%
65 or older	8	7%
Total	120	100%

Gender	Valid Sample	%
Male	76	63%
Female	44	37%
Total	120	100%

ETHNICITY	**Valid Sample**
Bangladeshi	100
Bihari	20

Table 7: Survey participant's profile- Tajmahal Road Park, Mohammadpur.

Leisure and park activity. The majority, 43% of the users, reported that they visit the park a few times every week, and 7% only less than three times (figure 14), mainly engaged in jogging, walking, running or exercise, relaxing, cycling, playing and meeting friends (figure 15).

Figure 14: How often do you visit your neighborhood park?

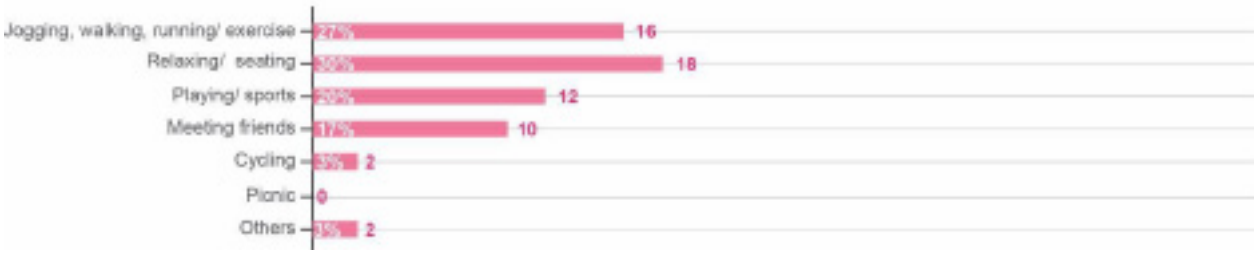


Figure 15: What activities do you most frequently perform in your neighborhood park?

Statement	Strongly Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Strongly Disagree
This neighborhood park is overall aesthetically appealing.	3%	30%	23%	37%	7%
This neighborhood park offers a good variety of areas with different ambient.	10%	13%	27%	37%	13%
The park shows obvious signs and features pertinent to different cultures.	23%	17%	13%	27%	17%
This park is often too crowded.	10%	7%	3%	40%	40%
Spaces in the park are generally clean and tidy.	80%	7%	7%	3%	3%
I often find spaces in the park smelly.	17%	17%	23%	10%	33%
I often find spaces in the park quite noisy.	17%	17%	23%	30%	13%
I feel overwhelmed and inundated in this park on an everyday basis.	7%	17%	37%	20%	20%

The shaded seating areas and circular fountains or bridges are the most frequented zones used and liked on a regular basis. The most disliked areas in the park are those near the toilet, near the noisy peripheral zone (adjacent to the road), and unshaded seating. With respect to sensory experience, users mostly somewhat agree that the park is aesthetically and visually pleasing and offers a good variety of areas with different ambient (e.g., fountain area and playfield). The users find their park untidy and smelly in quite a few numbers of zones in the park. However, many users stated that their park is frequently overcrowded (in the morning and evening hours) and noisy almost throughout the day (table 8).

Regarding their walking experience, the users prefer sheltered pathways surrounded by greenery but avoid dark and isolated places. Slippery paths, obstacles, and lack of companionship are among the critical barriers to an enjoyable walking experience (table 9).

Statement	Strongly Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Strongly Disagree
There are many obstacles to walking around in the park.	23%	20%	27%	23%	13%
The ground/floors in the park are slippery when it rains, and I feel unsafe.	3%	27%	20%	27%	23%
I hesitate to go to the park if there is no one accompanying me.	30%	13%	10%	3%	43%
Nature makes walking through this park more enjoyable.	3%	13%	10%	13%	60%
I avoid passing by rubbish, messy areas, and dark places.	0%	20%	13%	17%	50%
I always prefer walking on sheltered pathways.	0%	7%	3%	23%	67%

able 8: Do you agree with the following statements related to your walking experience?

Overall, most users are dissatisfied with the amenities available in the park. Facilities such as toilets and play zones are unusable, though 53% of the users feel happy living near this neighborhood park and find their neighborhood well-designed for all ages (table 10).

Statement	Strongly Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Strongly Disagree
Amenities in this park are well provided.	23%	27%	13%	33%	3%
There are plenty of opportunities for different generations (e.g., children and elderly) to meet.	10%	23%	7%	33%	23%
This neighborhood park is overall well-designed for all ages.	10%	33%	13%	17%	27%
I feel happy living near this neighborhood park.	7%	7%	3%	30%	53%

Table 9: Do you agree with the following statements related to your overall experience in this neighborhood park?

5. Discussion and Limitations

Based on the data from the survey of Justice Shahabuddin Park and Tajmahal Road park, the study finds that the visual perception of the parks includes viewing the natural elements (i.e., trees, light, and waters) and manufactured elements (i.e., pathways, built structures) plays a vital role in promoting more positive moods and feelings and contribute to stress recovery. The study also shows that the auditory comfort sensation generated in the parks by natural sounds, people sounds, quiet backgrounds, and less traffic noise contributed to a pleasant soundscape environment. The food smell encountered (Tajmahal road park) plays a significant role in triggering positive emotions associated with local flavors. The tactile sensation formulated by the contact with elements (i.e., waters, grass, trees, seats, lanes) contributes to the positive sensory experience and the user's frequency with which they visit the parks.

The research shows that parks' environmental factors and dominant sensory elements are responsible for forming sensory nodes. These nodes are the sensory richest places in the parks with the highest user occupancy and individual user personalities creating emotional experiences contributing to positive feelings such as interest, cheerfulness, and calmness, which could replace negative emotions and thoughts. From the activity pattern analysis, it has been observed that the dominant pedestrian pathways are primarily located near the active sensory nodes and remain unchanged throughout the day and week. The overall multisensory experience in Justice Shahabuddin Park was comparatively richer than in Tajmahal Road park, Mohammadpur due to its richness in sensory dominant elements and a greater number of sensory nodes. The overcrowded, overly human voices, and traffic noises in Tajmahal Road park also

created a negative impact on the userâ€™s sensorial experience when compared with Shahabuddin park. The socio-perceptual survey of the users in the parks also revealed the relationship between sensory dominating elements and the staying periods in the park. The results showed that aesthetically appealing, a good variety of areas, less noise, distinguishable textured pathways, and shaded, and uninterrupted walkways, make them want to stay longer in their neighborhood park. People's expectations of the sensory stimuli they will detect in different areas vary depending on the time of day, week, or year. Activities, environmental changes such as local vegetation, and climate influence it, all of which impact people's behavior. In both the studies of the parks, sensory walks provided participants with access to their views and sensory expectations of various natural environments in neighborhood parks, allowing them to explore differences and similarities between various on-site experiences and responses. The use of the smell, touch, taste, visual, and soundwalks also created experiences, providing a hands-on and participatory approach. Participants' reflections on the walks undertaken for this paper revealed that they felt they had learned and appreciated the natural environment more and would continue to consider olfactory, auditory, visual, gustatory, and tactile experiences within the neighborhood parks. This was particularly noticeable when participants from architecture students were taken on walks, as they felt that they had received an educational experience that would/may inform the future design of urban green space. In the future, the inclusion of local urban planners and stakeholders will undoubtedly positively impact decision-making. While the walking methodology intended not to influence perception from the beginning, hoping that participants would have "normal" experiences and responses within the spaces, perception no doubt changed focus as walks progressed, benefiting from bringing unconscious thoughts and feelings to the forefront.

6. Conclusion

Understanding the sensory experience of neighborhood parks requires a close look at the specific interactions between the senses, users, and those elements that make the individual senses significant and exciting. This paper outlined the documentation, analysis, and visualization of the multisensory experiences in two neighborhood parks of Dhaka City. This study underpins the need for more research in the sensory dimension of the user experience in neighborhood parks and its importance associated with well-being in the future. Consequently, further research should extend the research timespan to assess how important the sensory dimension of the experience is throughout the year. As a result, the study argues for more detailed and frequent consideration of sensory aspects as part of mainstream urban design and planning, development, and management practices, while also implying that attempts change or regulate olfactory, auditory, visual, gustatory, and tactile urban green space characteristics necessitate prior critical reflection. As neighborhood park users' multisensory experience plays a significant role in their long-term well-being, multisensory perception should be considered seriously when designing urban green spaces in Dhaka city, particularly in terms of the stimulating effects of visual, auditory, tactile, and olfactory sensations. Thereby, systematic and in-depth consideration of multisensory experience is a relevant and needed approach to forming meaningful, empathetic, and healthy neighborhood parks.

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Institutional Review Board Statement: The study was approved by the NSU Institutional Review Board (IRB)/ Ethics Review Committee (ERC) of North South University. (Ref: 2022/OR-NSU/IRB,1101).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Conflicts of interest: The author declares no conflict of interest.

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Location	Size and Shape	Physical features	Special features	Name of tree
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Table 6: Physical characteristics of Tajmahal Road Park, Mohammadpur.

Statement	Strongly Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Strongly Disagree
This neighborhood park is overall aesthetically appealing.	3%	30%	23%	37%	7%
This neighborhood park offers a good variety of areas with different ambient.	10%	13%	27%	37%	13%
The park shows obvious signs and features pertinent to different cultures.	23%	17%	13%	27%	17%
This park is often too crowded.	10%	7%	3%	40%	40%
Spaces in the park are generally clean and tidy.	80%	7%	7%	3%	3%
I often find spaces in the park smelly.	17%	17%	23%	10%	33%
I often find spaces in the park quite noisy.	17%	17%	23%	30%	13%
I feel overwhelmed and inundated in this park on an everyday basis.	7%	17%	37%	20%	20%