Light Memory, As a Design Tool

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Abstract

“Light memories” are visual episodic memories of a lighting composition that transcended an emotional response. The study considers the memories and how they could be a way to integrate users in the design process. Both designs and memories are considered two subjective elements, for both designers and users. The purpose of the thesis is to firstly test if there are common light memories for users that share the same specifics of the culture associated to the availability of daylight and secondly to explore the possibility of creating a design method to incorporate this light memory as a design tool, to recreate the similar emotional response of the memory in a newly designed setting.

Two street typologies in Egypt were chosen to be the visual memories to be assessed. A personal daylight analysis was conducted to understand the designer’s perspective. And a virtual reality experiment was conducted along with descriptive questionnaire to understand the emotional response of users to these streets. A comparison of the designer and users results helped in the creation of a scheme for design. The proposed method suggests the usage of perceptual tools such as the light distribution and contrast ratios and proposes the analysis of the memory in terms of scales. The method is applied in the creation of two experiential models that abstract the essence of the light memories and puts them into question for subjects to evaluate. The emotional response of users is recorded to evaluate the method application.

Based on the tests it was found that the existing of a common memory is possible. The evaluation of the specific street memory through the experiential model results show that a high percentage among the users sharing the same daylight culture recognized the streets. Although most users had the same emotional responses to the models, but the agreement on the emotional percentage amongst them was lower than the recognition results. This indicates that the memory could be integrated into the design process but wouldn’t necessarily have the same emotional impact on users. Having a strict design methodology is difficult to implement yet could be an eye opener for ways to use the light memories.

Keywords: Memory, Daylight, Experiential, Urban Experience, Light Culture, Emotion
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INTRODUCTION

During my studies I’ve had studied lighting from a Nordic perspective. Being originally from Egypt, I’ve faced difficulties understanding the lighting culture of Sweden, manifesting both light and darkness and appreciating daylight in summertime. When I came to think about daylighting in Egypt, I realized that I have a different memory associated with daylight in urban spaces like the strong direct sunlight, the tree shadows on the floors and the crowdedness of objects in the streets. Each of these scenes, triggered different feelings and emotions that I really missed in dark Sweden both in terms of daylight and low artificial light levels. Some scenes contribute to a relaxed emotion that relieves and calms my mind into a wondering scene, like in the calm residential areas of Maadi, while other stimulate my attention to visual frames that add to my excitement for exploration, like in the heart of Old Cairo.

From there I thought if this personal visual memory and its associated emotions is applicable for other users that share the same specifics of the Egyptian culture associated to the availability of daylight? On another level, how could this specific visual light memory be used as a design tool to recreate a similar emotional experience for users? The purpose of the thesis is to create an experimentation as an iteration to find a design approach with the memory of light by assessing the relation between the emotion associated with a visual light memory and the emotion of a newly designed experiential composition.

Aiming to understand the daylighting culture in Egypt, the thesis narrows down from the outdoor scale, to the urban scale and finally to the street scale. An analysis of the light memory is conducted from different street typologies that Egyptians experience on daily basis.

The thesis has two main objectives:

1. Approach for design in Egypt based on the street daylight culture to trigger a specific emotion: is there a common visual memory related with the specifics of Egyptian culture associated with the availability of daylight? Are the personal emotions associated to this visual memory?

   Method Brief: By analyzing two street typologies in Egypt, a personal understanding of the light culture and light episodic memory can be associated with personal emotions. The analysis will be associated with a virtual reality experiment and questionnaires, to be tested among other users with the similar Egyptian culture.

2. Methodology of using the memory of light as a design tool: How can the light memory of the street visual experience, be used to trigger a similar emotion in an experiential composition?

   Method Brief: An abstraction of the light memories will be translated into experiential spaces using the composition of light in each memory and two experiential models will be built. The pictures of the models and their associated emotion will be evaluated and compared to the virtual reality results.

Figure 1 - Personal image of Stockholm's Park in September 2017, showing users laying in the direct sunlight.

Figure 2 - Personal image of Old Cairo Selhedar street in April 2018, showing users avoiding direct sunlight and sitting in the shade.
A. PERCEPTION

1. Photo-receptors

The photo-receptors are concentrated in the middle in the “fovea”. With the eye movement, the human concentrates his vision in a specific point. In a virtual reality this movement is opt to occur a lot since the subject experiences the picture in an immersive environment (4). So even by focusing the vision of the subjects towards a specific direction, their foveal vision is gazing between various elements. It is difficult to fix the foveal vision of the subject on just one element. However the peripheral vision is still working to capture visual information about the environment and trigger an emotional response.

2. Visual Attention

The visual attention filters the information that should be retained during this mode and discards the unnecessary ones. This process of selection happens through a personal filter based on personal experiences and visual attention that according to (4) is “the small window into the world”. With it the visual information is processed into actual objects. In a virtual reality setting, the visual attention should be activated based on the given “Goals” to guide subjects to notice specific elements. To add meaning to the whole scene, the visual memory needs to be activated to restore the needed memory and use it to further “construct and stabilize” the scene (4).
B. MEMORY

1. Memory Stages

The visual information is acquired by the sensory memory that retains the sensory information for a short duration to allow the brain to process and reason it. After the visual attention filtration, it is then stored in two stages of memory: short-term and long-term.

Short-term memory

Short-term memory is the combination of all visual inputs to create a comprehensible scene of the current environment. The information is retained for a few seconds, giving the brain some time to reason the scene. Only rehearsed information is kept in the short-term memory, keeping the information for a long enough duration to be used or passed on to the next stage of long-term memory.

Long-Term Memory

It is the information stored for a long time of days, months, or years. Not any rehearsed information in the short-term memory will be transferred to the long-term memory, an encoding process needs to be done. Long-term memory is categorized into two main types based on the conscious awareness as shown. This paper focuses on episodic memories including the context, the time, and the emotion of an experience.

2. Memory Processes

The memory moves from the short-term stage to the long-term memory using specific processes:

1. Encoding: The organization of information that allows the shrinkage of information into smaller pieces through grouping or chunking it.
2. Storage
3. Recovery: The process responsible for recalling the memory. It’s composed of the “search” and its “retrieval” to reactivate it to the working memory again. This phase is really important in this experiment because through it, users should be able to recover the same memory in a different experiential composition.

3. Encoded visual memory: Scene Gist

The scene gist is the schematic version of the visual memory that the brain stitches together. It’s a whole composition created of various details that were captured during the stationary fixation period. This whole scene is composed of various elements:

- **Cityscape**
  - Urban setting, architectural elements, and materials
- **Lighting Setting**
  - Daytime, nighttime, dark or bright space, shadow patterns
- **Objects**
- **Natural Elements**
- **Human Elements**

Figure 3 - The explicit memory is the memory that requires conscious awareness and is divided into two kinds: semantic and episodic.
Source: After (7), Chapter 8
C. EMOTION

1. Emotional consciousness through self-reference

Episodic memory requires consciousness of the context as well as the emotions. Based on the higher order theory of consciousness (10), it is argued that the most important input that should exist for an emotional experience is the self-awareness element, meaning that the person puts himself in the center of the memory and assesses the memory based on his personal insights rather than just factual knowledge (10).

2. Emotions in Episodic memory

The experience of an emotion occurs when the person initially has an unconscious present emotional experience and an unconscious long-term memory of a similar experience. The retrieval of both elements generates a conscious emotion through a present working memory (10) (3) The autoneotic self-awareness is what contributes to the episodic memory as it links context with personal emotion in one experience (10).

3. Re-trigger similar emotions

One way of recognizing emotions is through visual cues (11). By seeing an image, the memory could be recalled and the initial visual experience can be remembered. This could lead to the retrieval of emotional memories as well. The visual cues could just be a feature that would trigger the long-term memory to recall the initial emotion. In an experiment testing the feeling of fear for mice, shows that recreating the same setting of a specific memory regenerates the same emotion of the scene they were exposed to before (12).

Applying this to the thesis, virtual reality can be a substitute for the actual daylight composition in the street, because subjects will recall the emotion of the familiar street by experiencing it a stationary virtual reality experience.

METHODOLOGY

A. Area of Study
B. Process
C. Sites Overview
D. Experiment
A. AREA OF STUDY

1. Defining the “Light Memory”

In this study, only visual memory is considered, also called “Light Memory”. There are three main elements that combined together create this memory. The perception is the visual photographic image that is perceived by the user created by the daylighting composition. The emotions represent the conscious feeling the user acquires during the experience. The associations represent the relevant personal affiliations to the space that the user has. These associations are what makes every memory unique to the person even if the perception and the emotions are the same. The light memory is the daylighting composition of a scene experienced then stored in a form of episodic memory that takes into consideration the emotions, context and time factors. This is only a visual memory that excluded other sensorial inputs.

2. Intervention in the memory process

The memory storage process is a key tool to understand the interventions of the study as follows:

3. Defining the Emotions

Based on a pilot study related to the stress level and the urban environment, the stress level increases in a built environment while it decreases in a natural environment. Therefore, two street typologies were addressed in this thesis: The spine street, where there is a built environment and a high level of urban interaction and the strip street where it is a more natural environment with residential function with minimal interaction. Looking at Cairo’s urban texture, the two areas of study are el Khan El Khalili street in Old Cairo and Hadayek street in Maadi.

Based on a subjective experience, as a local, this pilot study was personally valid. There were associated emotions while experiencing these sites: being relaxed in Maadi and being stimulated towards excitement in Old Cairo. The two emotions are not mutually exclusive yet represent different state of minds. This is why these two contrasting emotions were chosen in the study to understand if there is a common memory among other locals with the same daylight culture.
B. Process

1. Study phases

The study consists of mainly three phases:

1. Analysis of the light memory: The first analysis is carried personally, as a local and a designer recording qualitatively the daylight specifics. Then a virtual reality experiment allows the understanding of how users perceive the memory and their emotion. Then another questionnaire tries to encode their memory of the site in a descriptive way. At last quantitative results about luminance and horizontal illuminance are collected.

2. Abstraction of the memory: Using the analysis of the memory, an iteration to find a design method that could integrate the light memory is done to translate the essence of the memory into an experiential model.

3. Model Evaluation: Comparison between the subjects’ emotion and recognition while experiencing the experiential model and during the virtual reality.

2. Main Parameters

- Personal Assessment: The designer’s analysis of the street using contrast perception, distribution of light, patterns of light.
- Qualitative: The subjects’ experiment will fill a questionnaire about their emotion and perception of the pictures, then fill in a questionnaire about their memory of the sites and last a survey about the experiential interior model.
- Quantitative : Luminance, contrast ratios, illuminance street level.

3. Subjects of Study

The same subjects go through all phases of the experiment. The criteria to choose the subjects are as follows:

- Familiar with Sites
  - Have visited the sites of Maadi and Old Cairo before
- Various Backgrounds
  - Have different working and educational backgrounds
- Various Ages
  - Have different age groups
- Locals
  - With an Egyptian Nationality or have lived in Egypt for at least 15 years
- Have different age groups
- Differences
  - Similarities

Figure 9 - Subjects of study. The subjects are constant throughout the whole experiment, the main requirements are that they would be familiar with the sites and are locals who lived in Egypt for a long time.
C. SITES OVERVIEW

Basic information about the sites is tabulated as follows, as a start for a deeper understanding of the sites:

<table>
<thead>
<tr>
<th>Point of Comparison</th>
<th>Old Cairo (Spine)</th>
<th>Maadi (Strip)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban fabric</td>
<td>Built environment</td>
<td>Natural Environment</td>
</tr>
<tr>
<td>Privacy</td>
<td>Public</td>
<td>Semi public</td>
</tr>
<tr>
<td>Function</td>
<td>Mixed Use</td>
<td>Residential</td>
</tr>
<tr>
<td>Level of interactivity</td>
<td>Interactive</td>
<td>Individual</td>
</tr>
<tr>
<td>Street Width</td>
<td>Narrow (4 m)</td>
<td>Wide (12 m)</td>
</tr>
<tr>
<td>Buildings Height</td>
<td>4 floors</td>
<td>6 floors</td>
</tr>
<tr>
<td>Personal Emotion triggered</td>
<td>Relaxing</td>
<td>Stimulating</td>
</tr>
</tbody>
</table>

1. Historical Overview & Urban Fabric

In this study, the sites of focus are Old Cairo and Maadi. Although their geographical proximity, the sites vary in urban fabric and historical overview as follows.

Old Cairo- Islamic City

The city of Old Cairo was established by Amr Ibn-El-Ass in 642 (8). The commercial areas called “Wikalas”, incorporate several storerooms and an inner courtyard displaying goods. Wikalas are currently used for cultural events. The “khan” is another building typology which combined two functions of hospitality and trading (8). Khans are currently filled with shops on both street sides. The Islamic city combined all functions as shown making old Cairo the heart of the city that rapidly became denser hence creating an irregular harsh grain. The area is composed of small narrow alleyways, with adjacent buildings providing self-shading (1). Nowadays, tensile and metal structures are used to increase shading in these areas.

Maadi- Garden City

Maadi was established to serve foreign bourgeoisie in 1904 (5). It follows the garden city concept to allow the coupling the working and the recreation aspects in one setting. The design aimed to have luxurious residences following the shown layout. The houses were created in wide streets with lush gardens on a radial grid. At the intersection of these grids, boulevards were created providing common open spaces for residents (5). There were regulations for buildings in Maadi, where villas were built on a maximum of half the plot, had a limit of 15 meters height and had to be edged with a green belt and not walls (5). Nowadays, new buildings are built heightening up to 21 meters.
2. Users and Activities

Old Cairo

- Metallic Products
- Touristic Monuments
- Shading devices added by locals
- Residential

Touristic

Residential

Commercial

Textile products

Residents working in the bazaar

Products in touristic bazaars

Figure 15: Old Cairo’s users and activities. The area is mainly commercial and touristic, locals living in the area are also working in the shops. The street has a mixed use typology. Foreign tourists visit the Islamic architecture in the area and buy the local displayed products. Program: Photoshop

Maadi

- Recreational
- Residential
- Circulation

Bike Riding

Recreational Space and walking area

Security Guards for residential area

Youths taking pictures in the greenery

Parking

Figure 16: Maadi’s users and activities. The area is mostly residential were locals and other users enjoy the lush greenery to take pictures and gather with their friends. Streets are mostly calm with cars parking and bike riders. The street is mainly used for circulation. Security guards are usually in the street increasing the feel of the safety. Program: Photoshop
D. Experiment

1. Preparing the experiment

Street Orientation

While planning old Cairo the E-W orientation was avoided and all streets were oriented towards NE-SW or NW-SE to prevent the sunlight penetration on the ground level (1). To keep the study consistent, a street with the same NE-SW was chosen in Maadi. The selected streets are Haret Khan Elkhalili in Old Cairo and El Hadayek.

Time for taking panoramic pictures of the street

Since the street has a NW, SE orientation the shadows were minimum before noon. To take the pictures, the following timings were chosen. For the rest of the thesis, the maximum sun angle of 72 degrees, at 13:00 in end of April, is used allowing to create a broader daylight analysis in Cairo and not only specific to the street.

Criteria for edited pictures to be displayed in virtual reality

To focus on light qualities rather than colors, pictures were edited to be in black and white, hence allowing the study to disregard color interpretation (Appendix 1). To get accurate results among all subjects, they would evaluate the scene from a focal point on the street’s perspective. Pictures were chosen personally based on personal observation of an equal proportion between all planes (floor, ceiling and walls).

2. Experimental Set Up

Experiment

Twenty-six subjects perceived eight panoramic pictures in the virtual reality. An introduction about light and the experiment is done for subjects allowing them to understand the differences in light terminology. They evaluated their emotion either being relaxed or stimulated, neutral or other. Then seven questions were asked to raise their attention to some lighting impressions (Appendix 2). The order of the pictures is being random allowing subjects to not be fixated on a certain site. The following page shows these pictures in the screening order.
Subjects answered a succession of questions assessing the light in this memory while experiencing the virtual reality. The following questions will be addressed:

1. Emotion
2. Level of light impression
3. Light Distribution impression
4. High contrast, low contrast
5. Shadows impression
6. Plane the eye is attracted to: floor, ceiling or walls
7. Elements the eye is attracted to: objects or sunlight patterns

Two weeks after the virtual reality experiment, subjects recalled certain elements from their preconceived memory of the site. They were asked to describe verbally a relaxing experience and a stimulating experience. This would allow the shrinking of the experience into a smaller image in their memories, preparing them to evaluate the physical model.
Panoramic pictures viewed in virtual reality

Figure 21 - Edited panoramic pictures for virtual reality experiment. These edited panoramic pictures were screened in the virtual reality in the same order. Pictures have a focal vision in the middle and are in black and white. (Appendix 1) Program: Photoshop.
A. Streets’ Daylight Analysis

The daylight analysis aims to understand the daylight composition of the street. This analysis is a method to analyze the memory, from the designer’s perspective and allows him to have a method for decision making in the proposed design. This section is not a definitive method to analyze visual memories of light, yet it is a recommended process to allow designers understand the memory’s composition of an immersive scene. The proposed scheme comes in two phases.

1. Micro Scale analysis:
   - 1.1 Materials
   - 1.2. Reflections
   - 1.3 Shading strategies
   - 1.4 Street’s visual frames

2. Macro Scale analysis:
   - 1.1 Street Sections
   - 1.2 Street Storyboards
   - 1.3 Storyboard Sections
   - 1.4 Light Distribution
   - 1.5 Light Qualities
   - 1.6 Contrast Ratios

Figure 22: Daylight Street Analysis: The analysis of the street considers the micro scale level of details, then the macro-scale level that considers the composition of the whole experience.

1. Micro scale

The micro scale analysis explores the details of the scene meaning the elements that compose the wholeness of the experience.
Materials in each street: A comparison between Old Cairo and Maadi shows that the reflectance of materials in Old Cairo is higher than in Maadi, hence contributing to more visual noise. Reflectance values are adapted from (6).

<table>
<thead>
<tr>
<th>Materials</th>
<th>Old Cairo</th>
<th>Maadi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandstone</td>
<td>18%</td>
<td>25%</td>
</tr>
<tr>
<td>Limestone</td>
<td>25%</td>
<td>17%</td>
</tr>
<tr>
<td>Vegetation</td>
<td>25%</td>
<td>18%</td>
</tr>
<tr>
<td>Wood</td>
<td>17%</td>
<td>18%</td>
</tr>
<tr>
<td>Translucent PVC</td>
<td>18%</td>
<td>40%</td>
</tr>
<tr>
<td>Plated Copper</td>
<td>65%</td>
<td>7%</td>
</tr>
<tr>
<td>Granite</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Cotton Textile</td>
<td>25%</td>
<td>30%</td>
</tr>
<tr>
<td>Asphalt</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Earth</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Glass</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Plated Copper</td>
<td>65%</td>
<td>30%</td>
</tr>
<tr>
<td>Car Metal</td>
<td>47%</td>
<td>7%</td>
</tr>
<tr>
<td>Leather</td>
<td>40%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Reflections

Old Cairo

Based on the materials arrangement, the concentration of reflections in the scene varies from one side to the other, creating an alternating experience along the spine. The direct sunlight appears at the end of the alley and sometimes lights up the products of the shops.

Maadi

The reflections are created by the cars. They are emphasizing the street’s direction and depth along with the trees, creating a visual rhythm. Slighter reflections are created by the leaves, creating an overcast of play of brilliants.

Legend:

- Direct Sunlight
- Reflections
Shading Strategies

Fenestrations used to reduce glare at the buildings’ skyline

Mashrabeys projected from the building’s facade

Wooden window shutters to break direct sunlight in the interior

Metal structure with PVC cladding providing shade for commercial use

Direct sunlight penetrating through the shading structures

Merchandise displayed in the streets: metal and textile materials

Shaded and enclosed shop interior

Wooden pergolas used for shading

Balconies in residential buildings provide self shading for the building

Tree Leaves with varying densities providing playful shades

Property Fence

Cars parked under shades

Irregular shading created by trees

Old Cairo

Maadi

Figure 26: Shading strategies in Old Cairo: Metal and wooden structures are used as well as the mashrabeys.

Figure 27: Shading strategy in Maadi: Mainly trees and balconies and protrusions are used in architecture.
Street’s visual frames

Old Cairo

The visual frames represent the small images of the details that the eye captures and registered. As the human experience the whole street, some specific imageries are what shape the visual memory. In old Cairo, the objects and the intricate ornamental details of the architecture, with few marked shadows make the objects the most dominant features.

Maadi

The frames from Maadi are implying an interesting irregular play of brilliants created by the different light shadows and tree leaves layering. Shadows are marked due to the direct sunlight. In this memory the light becomes the most dominant element that captures the eye.

Figure 28: Possible visual frames in Old Cairo. Geometric patterns and rich ornamented objects are possible details that could be found.

Figure 29: Possible visual frames in Maadi. Mostly natural irregular patterns with varying densities and marked shadows compose the visual images of the site.
2. Macro scale

The macro scale analysis aims to understand the whole composition of the street and the different settings the user experiences while walking in the street.

**Street Sections**

- **Figure 29 - Old Cairo Street section**: There are two street types in Old Cairo, monumental bright streets and darker commercial streets.

- **Figure 30 - Maadi Street section**: Mostly wide streets covered with trees with a wide spacing between buildings and trees embracing the streets with shadows.

There are two street types in Old Cairo that vary in the area, some streets are dark and narrow, others are bright allowing the perception of architecture of Old Cairo.

In Maadi most streets are covered with trees with a wide spacing between the buildings.
Figure 31 - Old Cairo street
Storyboard: The street varies from dark commercial to brighter spaces. The direct sunlight sometimes appears at the end of the dark area and sometimes becomes the main luminaire that lights up the clustered merchandise.

Figure 32 - Maadi street
Storyboard: The street has a constant access to direct sunlight that creates soothing irregular shadows. The buildings appear and disappear between the tree leaves.
Storyboard sections

Old Cairo

Figure 33 - Old Cairo Storyboard section: The street has varying light levels. Users can walk in the shaded commercial area created by installed shades. Sometimes the direct sunlight penetrate the shading areas to create a contrasting sun patch. At the end of the alley appears the architecture of the buildings in the bright area intersections.

Maadi

Figure 34 - Maadi Storyboard section: While walking in the street there are three possible experiences, the first comes by walking under the tree shadows, or in an area where the trees are very dense creating a cluster of shadow or at last by walking in a bright space with direct sunlight. This variety of experiences create a relaxing rhythm of nature.
Scenes light qualities

Old Cairo

Figure 35 - Old Cairo Light Qualities: Old Cairo has mostly diffused light, direct sunlight exists in the sky plane mostly.

Maadi

Figure 36 - Maadi Light Qualities: Maadi has mostly direct sunlight, diffused light exists in the shaded areas.

Direct light in the ceiling accentuated by the shading structures. Diffused light illuminates the objects on the vertical elements and the architecture.

A direction of light appears creating two different qualities of light in each side. Direct sunlight is illuminating the trees in the whole scene. Diffused light is perceived on one side.
Accentuated ceiling with direct sunlight, along with some accents on an even distribution of objects. The accents on the vertical walls create a play of brilliants along the streets.

Even distribution of direct light in the street, vegetation has small accents on its leaves. Floor is accentuated by direct sunlight contrasting with tree shadows.
Contrast Ratios

Old Cairo

Figure 39 - Old Cairo contrast ratio: There is a high contrast ratio between objects that make the objects visible for users. Nuances are perceived between objects and contrast ratios between elements high allowing the perception of details. However contrast ratios are medium when the whole scene is perceived.

Maadi

Figure 40 - Maadi contrast ratio: There is a low contrast between tree leaves, yet a high contrast between shadows and direct sunlight. Extremes of brightness are perceived. Shades of trees are apparent to be close and perceived as a whole. Lower contrast ratios between trees allow the perception of only extreme brightness levels in the scene.
B. EXPERIMENT QUALITATIVE RESULTS

1. Qualitative Results: Virtual Reality Experiment Results

The analysis of the results (Appendix 3) is done in a comparative way trying to categorize pictures into two sets based on emotional response either being “stimulating” or “relaxing”. Then the tools assessing the visual memories would try to find a pattern between the different pictures. The questions (Appendix 2) try to understand the visual composition of the scene and the elements that capture the subjects’ eye the most in the memory.

Plane element of focus

In Old Cairo, the main element that caught the attention of subjects were the objects hanging in the commercial spaces on the walls making the vertical plane the main plane of focus with high contrast. In Maadi, the main element was the light patterns on the floor and the varying shadows, which makes the horizontal floor plane the most dominant, with high contrast.

Shadows Impression

The main difference consistent through all pictures was the shadows impression being vague in Old Cairo and marked in Maadi.

Emotional response

It was perceived that mostly users felt relaxed in Maadi and stimulated in Old Cairo, some subjects evaluated Old Cairo in an uncomfortable way either being visually crowded or narrow and dense.

Comparing stimulating and relaxing light patterns (light distribution, contrast ratios and shadows)

The blue lines represent the relaxing experience and they show a visually balanced experience where relationship between elements is linear. The orange lines represent the stimulating experience that has higher contrast ratios between objects in the scene, very vague shadows and a more uniform light distribution. Picture 6 and 7 (Appendix 3) don’t fall under the same pattern. In the picture from Maadi, vertical walls were considered the plane of focus while shadows on the floor remained the most dominant element, although there is a contradiction between the element and the plane the scene had 65.4% of subjects feeling relaxed. In the picture from Old Cairo, the perceptual lighting tools seemed to have the balance needed to have a relaxing experience yet the result was that 65.4% felt stimulated.
2. Results of questionnaire to encode the memory

A recall test was conducted allowing subjects to describe the visual image, emotions and associations with the specific sites. Some quotes from their descriptive paragraphs (Appendix 4) were recorded in the following scheme:

<table>
<thead>
<tr>
<th>Perception</th>
<th>Old Cairo</th>
<th>Maadi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane</td>
<td>Vertical walls with displayed items</td>
<td>Patterns of shadows on floor</td>
</tr>
<tr>
<td>Colors</td>
<td>Vibrant colors of products sold</td>
<td>Greenery, trees flower colors</td>
</tr>
<tr>
<td>Contrast Ratio</td>
<td>Low contrast due to low light level</td>
<td>High contrast of shadows and nature colors</td>
</tr>
<tr>
<td>Reflections</td>
<td>Copper and metal products</td>
<td>Cars and windows of residential buildings</td>
</tr>
<tr>
<td>Objects</td>
<td>Architectural elements</td>
<td>Natural elements, residential buildings</td>
</tr>
<tr>
<td>Shadows Pattern</td>
<td>Shading devices, silhouette of products</td>
<td>Shading devices hard shadows</td>
</tr>
<tr>
<td>Light Impression</td>
<td>Architectural historic element</td>
<td>Extreme of light and dark</td>
</tr>
<tr>
<td>Light Distribution</td>
<td>Variation from dark alleys</td>
<td>Bright street with</td>
</tr>
<tr>
<td>Street width</td>
<td>Narrow streets covered by structures</td>
<td>Wider streets embraced by trees</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emotion</th>
<th>Old Cairo</th>
<th>Maadi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual trigger</td>
<td>Historic layers</td>
<td>Architecture and products</td>
</tr>
<tr>
<td>Emotion</td>
<td>Relaxed Nostalgia</td>
<td>Stimulating and exciting</td>
</tr>
<tr>
<td>Associations</td>
<td></td>
<td>Relaxing and relieving</td>
</tr>
</tbody>
</table>

| Activities | Commercial, touristic | Social gatherings and visits |
| Day & night | Preferred at night to avoid product’s silhouettes | Preferred in the morning to see nature |
| Street Business | Crowded streets | Calm streets with few people and cars |

C. EXPERIMENT QUANTITATIVE RESULTS

1. Horizontal Illuminance and Luminance at the street level

Floor luminance

The street luminance in Maadi is much higher than in old Cairo and this is due to the direct sunlight exposure in Maadi. This shows that the flooring in brighter in Maadi hence emphasizing the feeling of the open land. The shading in Old Cairo resulted in a lower floor luminance which reinforced the impression of darkness in the space (Appendix 5).

Variation of Horizontal luminance along the street

In Old Cairo, the variations presented in the graph show that the street has varying brightness along the experience and that there are two street typologies: a bright space and a dark space as observed in the daylight analysis previously. The street in Maadi has an even level of light that is occurring due to the street’s openness.

Figure 47 - Encoded memory survey and extract from the subjects answers. Answers were divided into the three memory composition parts to be able to understand how people react to the light memories.
2. Luminance in scenes

The luminance false colors allowed the understanding of the light distribution and the composition of the scene. The analysis conducted here consists of seeing the percentage of low luminance, medium luminance and high luminance in the scene (Appendix 6).

In old Cairo the scene is mostly composed of low luminance. The high luminance indicates the direct sunlight in the sky and the reflections of the material which represents almost 4% of the scene composition.

In Maadi, medium luminance takes over the scene and is located mainly on the floor and illuminated trees. Then the low luminance occupy a big part of the scene in the shaded areas. The sky view symbolized by the high luminance is higher than in old Cairo as it represents the unshaded areas of the floor.

Figure 51 - Pictures’ luminance false mapping: Old Cairo pictures are composed mainly of low luminance, while Maadi pictures are mainly composed of medium luminance. The High luminance is barely appearing in both sites.

Figure 52- Luminance average values in false color mapping. Luminance values in Maadi are considerably higher than in Old Cairo.

Figure 53- Luminance composition in false color pictures. This graph shows the composition of the pictures. Old Cairo pictures are composed of low luminance, while Maadi is composed of mainly medium luminance. High luminance is slightly appearing in both sites, yet represents a higher percentage in Maadi. This means that Maadi is considered brighter than Old Cairo.

Percentage of luminance in the scene

Old Cairo Maadi

Low Luminance
Medium Luminance
High Luminance

58.55% 30.68%
37.31% 13.26%
56.06% 4.15%
A. Results Analysis

1. Contrast Ratio

In old Cairo, the elements attracting the eye the most are the objects on the vertical plane, while in Maadi the light patterns are more dominant on the floors. Regarding the contrast ratio, the quantitative results go with the daylight analysis results, the contrast ratio was perceived to be high in the in Old Cairo. In Maadi, with a focal vision on the shadows, a high contrast level could be perceived, which contradicts the low contrast level perceived on the trees leaves.

2. Light Distribution

In Old Cairo, the light distribution was perceived to be uniform in the scene and evenly lighting all objects simultaneously. Since the plane of focus was the vertical plane of the walls, so the accent created in the sky was not the most attractive element of the scene hence letting the participants perceive the scene more uniform and disregard the sky view. In Maadi, the light distribution is varying when the scene is perceived, yet on the street scale it is considered more uniform.

Discussion

A. Results Analysis
B. Proposed Scheme
3. Elements and planes

There is a gap between the personal analysis and the perception of the subjects in the experiment. While the designer focuses on the whole experience and the overall scene of the memory, the subjects focus on the details in the scene, specific objects or light visual frames is the key element on which subjects answer questions about their lighting impression. Subjects in Old Cairo focused on the objects displayed while in Maadi they focused on the light patterns and shadows in the scene.

B. PROPOSED SCHEME

1. Memory scales

Three scales of visual memory

Based on the results and the variation in personal analysis and experiment results, the designer takes into consideration the overall experience that allows him to perceive overall light distribution of the street and that subjects look at specific details that allows them to perceive contrast ratios. This is why the memory could be addressed in three different scales:

1. The overall experience that represents the walking spatial experience in the street with all its variations and storyboard.
2. The scene that represents a still panoramic peripheral scene with visual information.
3. The details that represent small portions or visual frames that compose the scene.

Looking at the memory in various scales allows the differentiation between the two notions of light distribution and contrast ratio. On one side, contrast ratio means proportion of difference in shades or tones of one element, it suggests focal vision on the detail level of an element. On the other side, light distribution suggests peripheral and wider angle of vision on an experiential level. This indicates that the overall experience could be composed of various detail contrast ratios, that arranged together create either a varying light distribution on the whole experience or a uniform one. Both tools are perceived together in the scene intermediate scale allowing a visual composition to appear where details are still perceived and overall experience is predicted.
2. Proposed Method

Intervention of the designer

The experience is considered a composition of elements, arranged in a storyline of an overall experience. With the contrast ratio as a perceptual tool to understand details and the light distribution as a perceptual tool to understand the overall experience, the designer can start abstracting the scene into an experiential configuration. The designer could intervene in the composition of the details as well as write the storyline of the space. He doesn’t have to intervene in each scene of the design as it will be subconsciously experienced from the user with the existence of fine details and an intact overall experience.

**Figure 63**: Intervention of designer in specific memory scales: The designer could use the light distribution to design the overall experience and the contrast ratio to design the details of the experiential space. The overlap of both scales would create the scene that would be experienced by users.

### Perceptual Design Tools

In this experiment specific perceptual tools were used to design the overall experience and the details of the scene, each element is aiming to abstract a specific memory gist as follows:

**Figure 64**: Perceptual design tools. For each scale some designing tools are attributed as a proposal to design each scale.

---

**Method Application**

A. Proposed Design  
B. Model Evaluation
A. PROPOSED DESIGN

1. Street Essence

To apply this design method on the sites, an abstraction of the memory needs to be done. First, this is a recap on the sites’ perceptual lighting tools and how they differ from a site to the other. Based on both sites analysis, the results were divided on the three scales of the visual memory.

---

**A. Proposed Design**

- **Shading Strategy**
  - Wood and PVC Structures

- **Scene Light Distribution**
  - Ceiling or sky accent with the direct sunlight from shading structures, while rest of the scene being uniform

- **Scene Contrast Ratio**
  - Medium Contrast Ratios allowing to perceive object differences yet bulks of brightness and darkness.

- **Street Experience**
  - The visual experience varies from dark narrow commercial spaces to brighter streets.

- **Reflections & Materials**
  - Reflections appear on vertical planes in different locations based on the arrangement of the displayed items in the shops.

- **Light Quality**
  - Defined direct light accentuates the middle and the ceiling. Whole diffused light is illuminating other objects in an even distribution.

- **Detail Contrast Ratios**
  - High contrast ratios allowing the perception of nuances and differences of objects. High contrast is created when there is a direct light with the shading structure.

- **Shadows**
  - Shadows are vague with the diffused light.

---

**Legend:**

- **Detail**
- **Scene**
- **Overall Experience**

---

**Old Cairo**

- **Shading Strategy**
  - Trees with uneven openings and spacing filters the light.

- **Scene Light Distribution**
  - Direct light is evenly distributed among the whole scene while floor shadows and sky view create a slightly varying light distribution.

- **Scene Contrast Ratio**
  - Medium Contrast Ratios allowing to perceive object differences yet bulks of brightness and darkness.

- **Street Experience**
  - A smooth slightly varying rhythm is created with the alternation of shade created by the arranged trees.

- **Reflections Distribution**
  - Reflections are created by the car metals and glass. Reflections are emphasizing the sense of perspective and reinforce the rhythm of the street by defining its edges.

- **Light Quality**
  - There is an interesting interplay between diffused light and direct light created by the shadows of the trees where direct lighting is covering the whole scene since it is an open lad street.

- **Detail Contrast Ratios**
  - High contrast ratios between tree leaves shadows and objects due to direct sunlight.

- **Shadows**
  - Shadows are marked yet has a combination of soft and hard edges due to the varying height of the leaves.

---

**Maadi**

- **Shading Strategy**
  - Scene with uneven openings and spacing filters the light.
2. Light Distribution and Contrast Ratio Concept

From the street’s essence a scheme of how the contrast ratio and the light distribution in each site was examined and marked differences in the details of each sites as well as the overall experience.

For Old Cairo, the site is composed of recognized objects with medium contrast between all of them on the vertical plane. However, the light distribution along the overall experience scale varies from a street to the other from bright to dark. In the scene the user perceives low contrast objects with a uniform light distribution since his focus is on the objects. For Maadi, the site is composed of high contrast shadows of natural elements on the horizontal plane. The light distribution in the overall experience is considered bright and uniform, while in the scene users are seeing a varying rhythm of shadows and direct sunlight created by the trees, and the contrast ratio of shadows drops from high contrast to medium since the whole composition is perceived rather than the details.

3. Perceptual Design Tools

To translate this concept into a physical model, the perceptual tools for each site were identified as an attempt to distinguish between them and the creation of different emotional responses.

<table>
<thead>
<tr>
<th>Perception tools used</th>
<th>Old Cairo</th>
<th>Maadi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Vertical Walls</td>
<td></td>
<td>1. Medium Contrast ratio</td>
</tr>
<tr>
<td>2. Alternating between sides</td>
<td></td>
<td>2. Varying Light Distribution</td>
</tr>
<tr>
<td>3. Dark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Contrast ratios</td>
<td>1. Low Contrast Ratio</td>
<td>1. Horizontal Floor</td>
</tr>
<tr>
<td>2. Light Distribution</td>
<td>2. Uniform Light Ratio</td>
<td>2. Intersection of floor and walls</td>
</tr>
<tr>
<td>3. Light Level Impression</td>
<td>3. Varying Light Distribution</td>
<td></td>
</tr>
<tr>
<td>Details</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Objects recognition</td>
<td>1. Products and architectural elements</td>
<td></td>
</tr>
<tr>
<td>2. Shadows Pattern, shading strategy</td>
<td>2. Regular and strict patterns (human elements)</td>
<td></td>
</tr>
<tr>
<td>3. Intersection of floor and walls</td>
<td>2. Irregular natural shadows with varying densities</td>
<td></td>
</tr>
</tbody>
</table>

Figure 68: Perceptual design tools used for design

4. Model Parameters

The aim of the model is to create an abstract experiential lighting composition that captures the essence of the scene. Some constant parameters were chosen to make both models comparable, such as the form, size and the usage of one light source. The other variables consider the light source position, materials and openings’ size and distribution.

Figure 69: Model dimensions
5. Experiential Sketches

**Overall Experience**
- Scene
- Light Distribution

**Contrast Ratio**
- Medium contrast
- Details
  - Abstraction of products and architectural elements
  - Regular and strict patterns (human elements)

**Light Distribution**
- Low Contrast Ratio
- Uniform Light Distribution

**Perceived Contrast Ratio & Light Distribution**
- Varying overall experience
  - Plan
  - Section
  - Opening at the ceiling giving a hint of the varying light distribution street experience from narrow dark to wide bright.
  - Surface at the end emphasizing the uniformity of the overall experience.
  - Generally bright space with a uniform overall experience.

**Blow Up on detail**
- Irregular pattern representing natural elements
- High contrast pattern with varying densities
- High contrast detail

**Viewing** reflected light and light directed from the opening together allow the perception of low contrast.

**Reflected light** represent the objects’ crowding in Old Cairo.

**Opening** with self-luminous surface

**Light** at the end showing a varying experience.

**Openings** bringing in light into the model, contrasting with the walls.

**The openings** and reflected light create a uniform light distribution.

**A uniform light distribution** in the whole scene with a darker light level impression.

**Feeling of stimulation** created by alternating views on both sides.

**Shadows** with different angles triggering the mind to think and observe.

**Surface** at the end emphasizing the uniformity of the overall experience.

**Natural pattern** with high contrast

**Reflection** in the corner creating a soothing emphasis on the perspective representing the cars

**Generally bright space with a uniform overall experience**

**Reflected light** varying along the model representing cars

**Natural pattern with high contrast**

**Bright even light**

**Uniform overall experience**

**Horizontal Floor**
- Intersection of floor and walls (representing cars)
- Bright

**Reflected light overlapping the openings**

**Light at the end showing a varying experience.**

**Alternated view on the other side**

**Shadows with different angles**

**Figure 76. Design personal sketches, showing design approach application on various model scales.**
6. Design Drawings

Old Cairo

Maadi

7. Model Construction

Old Cairo

Maadi
8. Experiential Model

Figure 77 - Old Cairo Model Scene Picture for experimentation pictures (Appendix 7)

Figure 78 - Maadi Model Scene Picture for experimentation pictures (Appendix 7)
B. Model Evaluation

The evaluation of the model was a way to test the method approach proposed. The test was
done through an online survey showing pictures of the model from different angles. Subjects
had to choose how does the scene make them feel and which site does it remind them of as
a way of recalling the memory of the streets through recognition test trying to associate the
scene with an emotion and attribute it to a site based on their encoded memory.

The results below show there is a fair percentage of subjects that share the same emotional
response of each model, and that there is a greater agreement on the attribution of the
model to a site (Appendix 8).

The results below show there is a fair percentage of subjects that share the same emotional
response of each model, and that there is a greater agreement on the attribution of the
model to a site (Appendix 8).

Figure 81 - Model Evaluation questionnaire results. There was a higher agreement
on the attribution of the model to the correct site than the agreement on the emotion.
However, most users agreed on the stimulated emotions in Old Cairo and the relaxed
emotion in Maadi.

CONCLUSION
**Conclusion**

1. Common Memory for users sharing the same daylight culture

Existence of a daylight culture?

From the virtual reality experiment, most subjects agreed on a stimulated in Old Cairo and on a relaxed in Maadi. This could be related to the relation between the built and natural environment and their effect on stress level (3) and their preconceived encoded memories of the sites. Since the topic of designing with the memory is recent, the model evaluation was conducted to test the design method allowing the comparison of results. This model captured the essence of each site and allowed the subject’s memory to recall the site using the perceptual design tools in terms of light distribution and contrast ratio.

![Comparing emotional response in VR and model](image)

Designer’s assumption vs. user’s perception

As a designer, it is important to take a step back and understand what the user actually perceives. The designer is at the end the decision maker, but the start should come from the user’s memory. In the virtual reality experiment, the results conflicted with the personal analysis of the street. This is because the subjects were having a focal vision on specific elements while the personal interpretations took into consideration the whole panoramic image. From these conflicting results, an understanding of the scales of the memory is important to entangle the user’s memory, and helped the creation of a framework for designers.

2. Light Memory integration into design methodology

Design Method evaluation

A designer shouldn’t just rely on the perceptual tools, but should try to understand what’s beneath the memory using his observation. The qualitative questionnaire about encoding the memory gave more information than the experiment light impression questions, especially with the recall method where subjects are free to describe what comes in their mind. This is where the designer should include himself in the process of abstraction and try to unravel the core of the experience that the user is describing from his memory, these narrative inputs referred to as poetics.

The fewer the number of subjects are the more accurate the memory can be translated into a design. Unlike other studies because what is true in the memory of a person is not necessarily true for others. The user recalls poetics of specific recognized objects. The addition of recognized objects besides the usage of light distribution and contrast ratio could be incorporated in the design methodology to ease the recalling of the scene.

Object recognition and Light distribution

Based on the virtual reality experiment, most of the pictures had an emotional response resulting from the light distribution. There were two outlying pictures in the virtual reality experiment. This shows that the perceptual tools on their own are not sufficient for design, sometimes just the element of greenery could be the main trigger of a relaxing experience.

![Object Recognition and Contrast ratio](image)

Object Recognition and Contrast ratio

We tempt to see identifiable objects over light patterns. Light is still and underlying element that is not comprehended by everyone. In this method application, contrast ratios were used to abstract the details of the scene. In design, this contrast ratio could be associated with some objects to increase the impact of the emotion. The essence of the objects in the memory could be used. Besides object’s contrast ratio, the shape, size, proportion, form and materials could be designed to contribute to a stronger emotional response and easily recall the initial memory of users.
The role of the designer

Although it is difficult to put a design methodology, it is preferable that the designer addresses both design scales: the elements scale and the overall experience. It is important to look for these scales in the encoded memory of the user and try to abstract it. Abstracting the elements of the memory is a subjective process. In this phase the designer can try to look at the element in various way and could have various concepts to achieve this memory abstraction. The designers’ willingness to look for details is the key for an experiential design. On another level, designing the overall experience can be done through other tools besides the light distribution like colors, qualities and form of light.

At the end, the designer creates the design based on what he thinks is a stimulating or a relaxing experience. His personal memory decides on how the newly designed composition would be for the user, who himself has different memories. The design methodology is a proposition of some perceptual tools to consider but doesn’t address how the composition comes together leaving room for the designer to innovate.

3. Further recommendations

Analyzing the memory of a user to integrate it into design could be a interesting way to create more personalized designs and integrate users in the design process. The integration process here was chosen to be through surveys and a virtual reality experiment. The screened pictures could have incorporated a 360 technology to ensure the immersiveness. Using the visual attention by setting goals to the subjects, further research could be done regarding several variables like colors and geometries dominating the scene. The light composition attributes to what the user’s eye sees and not necessarily to what the scene actually is. Therefore, the experiment could be done using any scene, like images, drawings or art pieces.

It is really difficult to assess the memory due to its subjectivity, hence the difficulty to adapt a design methodology, only tools of design could be suggested to translate this abstracted memory into a composition. The tools used here are the light distribution and contrast ratios. However, other tools like colors, forms and shapes could be adapted and experimented with. It could also be interesting to go a step further and explore how this light memory get be translated into a functional space.

Due to time limitation, the model was evaluated with an online survey. Other various assessment methods could have been used to increase the results’ accuracy such as the virtual reality method that ensures consistency throughout the whole process or building a 1:1 model.

Integrating the personal memories of a user into the design process is an interesting approach to create more personalized designs with higher impact, the way we perceive scenes around us influences our perception of other spaces and our emotional response. The topic of the memory and design is yet broad open possibilities to be explored.

References

(9) Kurt, Beil and Douglas, Hanes, “The Influence of Urban Natural and Built Environments on Physiological and Psychological Measures of Stress—A Pilot Study” Helfgott Research Institute, National College of Natural Medicine, Portland, USA, 26 March 2013.
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APPENDICES

Appendix 1 - Setting for editing pictures (Photoshop)
- Blurry peripheral vision
- Clustering Filter to create grouping of light (cutout)
- Opacity of the layers is as follows: (Black and white 90%, Gaussian Blur 50%, Cutout 70%)

Appendix 2 - Light Memory Panoramic pictures experiment questionnaire

1. How does the scene make you feel?
   Mark only one oval.
   - Relaxed
   - Neutral
   - Stimulated
   - Other:

2. What is your impression of brightness in the scene?
   Mark only one oval.
   - Low
   - Medium
   - High

3. What is your impression of light distribution in the scene?
   Mark only one oval.
   - Uniform
   - Varying
   - Other:

4. What’s your impression of shadows in the scene?
   Mark only one oval.
   - Dark
   - Medium
   - Bright

5. What’s the element your eye is attracted to the most?
   Mark only one oval.
   - Illuminated objects
   - Shadows / light patterns on surfaces
   - Other:

6. What’s the plane your eye is attracted to the most?
   Mark only one oval.
   - Floor
   - Walls
   - Sky

7. What’s the plane your eye is attracted to the most?
   Mark only one oval.
   - Stimulated
   - Neutral
   - Vague
   - Marked

8. What’s the plane your eye is attracted to the most?
   Mark only one oval.
   - Illuminated objects
   - Shadows / light patterns on surfaces
   - Other:
Appendix 3 - Light Memory Panoramic pictures experiment results

Picture 1: Maadi

1. What is your impression of brightness in the scene? (26 responses)

2. How does the scene make you feel? (26 responses)

3. What is your impression of light distribution in the scene? (26 responses)

4. What is the plane your eye is attracted to the most? (26 responses)

5. What is your impression of contrast ratios? (26 responses)

6. What is the element your eye is attracted to the most? (26 responses)

7. What’s your impression of shadows in the scene? (26 responses)

Picture 2: Old Cairo

1. What is your impression of brightness in the scene? (26 responses)

2. How does the scene make you feel? (26 responses)

3. What is your impression of light distribution in the scene? (26 responses)

4. What’s the plane your eye is attracted to the most? (26 responses)

5. What is your impression of contrast ratios? (26 responses)

6. What’s the element your eye is attracted to the most? (26 responses)

7. What’s your impression of shadows in the scene? (26 responses)
Appendix 4 - Qualitative results of the Recall Test- Encoding the memory

Answers of subjects are noted below with the author’s remarks.

1. Old Cairo: Imagine walking in the streets of KHAN EL KHALILI, describe the daylighting in the street (shadows, patterns and brightness impressions)

- The photographic VISUAL memory: your emotions - personal associations (what the space means to you)

- Write a paragraph.

  Imagine shadows falling off the eaves, squares and planters. The windows are large, reflecting the blue sky. The streets are narrow and the lights are indirect and shadows are comfortable. The congestion, which I find unforgiving, is soothing to the soul. This is one of the unique features of the feeling comfortably and in the streets.

  Add the layer of visual memory to the vast space, and the sun is on the move. The contrast between light and shadow is evident. People are walking in groups, some are talking, others are walking, and others are just passing by. I am filled with this energy, I want to stand there and appreciate the little things that we take for granted. The place is so busy, but I imagine the mental layers of history that compose this space, but anonymously, I stand and I observe the action happening around me. I need to watch it for my beholder, I have to make sure I do not get lost in the space, even though the space itself is really comfortable. The presence of this space has simply changed the original light and space.

  1. Daylighting
  - Lunk of shadows and patterns in the architecture present in the space and thus the presence is reinforced.

  2. Photographic Visual Memory
  - Always remember the better areas with the shops or the historical buildings. Have been there during the morning and night time, however, I feel the presence of the place more during sunset and later into the night, where the space becomes more open, and the sunlight.

  - Your memory
  - Your emotions
  - Your personal associations

- Personal associations

  This is one of my favorite places in Cairo. There is such a wonderful air and aura to it. The streets of Khan El Khalili are unique; they have a certain charm that is not like any other place I have visited.

  In the afternoon, there is no daylight. There are no shadows, so it seems to me that I feel I belong there; however, it is still a beautiful place filled with many activities that make it fun.

- Personal associations

  This is one of my favorite places in Cairo. There is such a wonderful air and aura to it. The streets of Khan El Khalili are unique; they have a certain charm that is not like any other place I have visited.

- Personal associations

  I can only remember it through the time it was there. I have not been there since then. I remember that before the ancient times, there was not much, other than a stone wall that shielded the city. I have not been there since then because it was not as it was before.

- Personal associations

  In the afternoon, there is no daylight. There are no shadows. I find that I belong there; however, it is still a beautiful place filled with many activities that make it fun.
2. Maadi: Imagine walking in the streets of MAADI, describe 1- the daylighting in the street (shadows, patterns and brightness impressions) 2- The photographic VISUAL memory 3- your emotions 4- personal associations (what the space means to you)? - Write a paragraph.
### Appendix 5 - Horizontal illuminance and luminance at the street level along the street

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Street</th>
<th>Horizontal lights (lx)</th>
<th>Floor luminance (floor reflectance 7%)</th>
<th>Average street illuminance (lx100)</th>
<th>Average Floor luminance (cd/sqm)</th>
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<tbody>
<tr>
<td>6-Apr-18</td>
<td>Maadi</td>
<td>Hadayek Street</td>
<td>97</td>
<td>260.69</td>
<td>121.2105263</td>
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Highlighted rows indicate the values for pictures used in the virtual reality experiment. Picture’s number is indicated in the gray circle.

### Appendix 6 - Composition of False Luminance pictures in scenes

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<th>Average Luminance of all pictures in site (cd/sqm)</th>
<th>Percentage In the picture</th>
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Highlighted rows indicate the values for pictures used in the virtual reality experiment. Picture’s number is indicated in the gray circle.
Appendix 7 - Model Experimentation Pictures

Maadi

Old Cairo
Appendix 8 - Model Evaluation results

Old Cairo

Maadi