Original Article

Impact of street path's form on achieving human scale in a city

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Abstract

A city's human scale can be achieved if people recognized the four Cardinal Directions (CDs) anywhere within the city. As a reflection of the theory of 'prospect and refuge,' this paper investigates the problem of losing a city's human scale, by studying the impact of the form of the street paths on maintaining and perception of the four CDs. The paper highlights the problem of a non-designed street network and the heterogeneity of its texture. The paper explores the impact of such random street networks on achieving the human scale of cities. Kharga City in Egypt located on (25.4390° N, 30.5586° E) is an example of cities suffering from non-designed street networks. Therefore, the paper relied on the inferential statistics approach by surveying a sample of residents in Kharga City, with the assumption that, the main reason for that problem was the various curves existing in the street paths, which had different shapes, sizes, diameters, and directions. Moreover, the lack of a typical street network pattern had aggravated the problem. Analysis and results confirmed the hypothesis of the research, hence basic recommendations were made. The most important of which is, the need to avoid random curves in street directions, and to follow the orthogonal grid pattern, mainly in the design of street networks, in order to ensure a city with human-scale, that is easy to recognize its correct mental map.

Keywords: Cardinal directions; Human-Scale City; City mental map, Street network planning

1. Introduction and Literature review

1.1. Preface

The theory of "prospect and refuge" informs that people derive perceptions of safety and pleasure from inhabiting environments that offer both uninterrupted views and a sense of enclosure [1]. Meaning that people need to clearly see the changes in the roads paths to obtain safety, therefore, urban planners, architects, and landscape designers have applied such theory to a certain extent. Professional and students have simple understanding of the idea of prospect-refuge, which is a formula for creating human-scaled space [2]. This article therefore explored human-scale in a city considering that protection and perception are the most important factors to achieve feeling of human-scale in the city [2]. Brindle argued that there are only two patterns of street network: the grid network structure and the tree network structure, distinguished by the degree of connectivity of roads [3]. However, Ravishankar stated that there are four patterns of street networks, such as gridiron, radial, radio-centric, Irregular [4]. Another classification is made by Southworth & Ben-Joseph, they stated six classes of street pattern: Gddiron, fragmented parallel, warped parallel, loops and lollipops, and lollipops and stick. In recent decade, researchers have focused on three aspects: hierarchical structure, connection structure, and layout structure [5]. Based on search in many of related databases, the author argues the literature on street networks did not focus on the effects of the roads' networks design on the human-scales of cities. Thus, the paper focus on the tree network structure which is not taking regular shapes and angels of intersections.

The human scale city means making sure that objects in a city are of sizes and shapes, reasonable for an average person for comfortable use [6]. Furthermore, ancient Egyptian civilization hieroglyph language indicated the word "city" by an illustration of a circle and a cross, meaning an interrelation between protection and central location [7]. The human-scale of the public spaces including streets is important to achieve standard environments and without external interfering when strolling in the city [8]. The deficiency of human-scale of public space affects the rate of criminal acts [9].

There is no doubt that the shape and composition of the street network, patterns, and characteristics of those streets have an impact on achieving the human scale within the entire city. The city's human scale entails achieving social cohesion, security, and safety among the residents. It helps people understand the city's urban pattern, draw a mental map of the city that can be a reference for describing places relative to others, move from one place to another easily and quickly, or/and specify a specific direction such as the direction of the *Qiblah*. Several factors strongly affect the extent to which the human scale is achieved in the city and its streets, the most important of which are the size and area of the city, the average heights of buildings, and the pattern and shape of the street network. The increase in the city's population, the expansion of its area, and the increase in the number of floors in the buildings lead to the loss of the human scale of the city, especially in cities whose streets lack visual formation and whose buildings are characterized by boredom and lack of diversity. Thus, the size and area of the city adversely affect the achievement of the human scale. Consequently, this research paper focused on the pattern and shape of the street network as a vital factor of the research problem.

It is commendable that, digital revolution has advanced so far with its expected effects of new capabilities and modern methods that allow car drivers to determine their locations and directions via satellites [10]. However, such technologies do not achieve personal awareness of directions and locations. They merely acquire temporary knowledge that people cannot store in their minds. The person who lives in a human-scale city or who visits it for the first time could store the correct mental map in mind. That correct mental map helps the person to recognize or know the Cardinal Directions (CDs). Therefore, city planners should follow specific methods to plan the street network to make it easier for the average person to recognize the CDs so that he/she can feel the human scale within those cities.

1.2. Factors of perception of CDs

1.2.1. Human Factors

Observation of elements is not sufficient to create the complete image of any city, but the hierarchical values of the elements that lead to perceiving the city image is very important [11]. Human factors, such as age, gender, education level, and the level of mental comprehension of the surrounding variables have vital impacts on visual process, understanding the data, and perception

of CDs [12]. To a certain extent, the human ability of perception and age have an expulsion relationship; the perception increases with age to a certain extent and then decreases with age [13]& [14]. A high level of education of the skillful people positively affects the ability to recognize, where people can acquire the perception of CDs from knowledge and insight [15]. Gender is a relatively influential factor in the ability to recognize where males' particular interests differ from female ones. Therefore, the males are more interested than the female in the perception of CDs [16]. The level of mental comprehension is a highly influential factor. The spatial thinking of people with a high level of comprehension of the variables surrounding them helps to correctly draw a mental map for the sites that were seen even once [17].

1.2.2. *Urban Factors*

The main function of the streets is supporting the residents' mobility, thus according to Dewi et al (2020) accessibility, distance, and the interrelationship between locations are the three main factors affecting the mobility in the streets [8]. The factor of accessibility here means the characteristics of street, bridge, pedestrian way, motorbikes track, or bicycles lanes that provide the ability to peoples to reach certain places [18]; The distance factor that affect mobility is the actual measure of the movement path from site to another within the city [19]. such distance is associated with the ability of peoples to compare location of one site with another one [20]; The term of interrelationship between locations is defined as the unity of the system between locations that people could maintain perception of the directions [21]. Soliman and et al (2014) have another argue of the public space function, they emphasized the public space must provide safety to residents [22].

The structural scheme of the city is the most important urban factor that effect the perceiving the city image, including street networks, because shifting of people and their spatial orientation are the most vital city functions [11]. The size of the city, its area, the heights of buildings [23], the diversity in the visual formation of urban spaces, the orientation of buildings and streets, and the degree of curvature of street directions are all urban factors that effectively affect the possibility of human perception of the CDs. A large and crowded city does not give a person a chance to meditate on it and compose it in his mind, unlike a small city in which a person can monitor and contain all the landmarks in it. The ability to recognize directions is also reduced in large cities, where it is infrequent that all of their locations and suburbs are familiar to one inhabitant, which

reduces the chance of memorizing the image of the city map. Buildings' heights harm achieving the human-scale city feeling. High-rise buildings reduce people's ability to monitor the formation of the skylines of the streets, leading to the failure to preserve the landmarks of the streets [24], which are considered reminder points that can be sites for changing the direction of the street. As for the diversity in the visual formation of the streets and squares, it helps the person to memorize the city map, which helps him to recognize the different directions of the streets. While directing the majority of the city's streets and buildings to the four CDs helps man acquire the skill of deducing directions in different city locations. However, the wide curves of the city's streets are not recognized by man instinctively, which leads to the inability to recognize directions or even infer them. The streets are one of the essential elements of the city. Thus, city planners should consider the rapid progress of transportation, which will make most of the current cities' streets more like the old Cairo lanes and the roads of medieval cities [25]. Thus, the research focuses on the streets' roles in achieving the humane scale of the city.

1.3. The problem and objective

One principle of any city is that everything should be easily accessible to all residents because the forms of cities affect the urban environment and social quality [26]. Such accessibility not being achieved without human scale in the city. Many people interested in urban planning believe that only the metropolitan city, particularly, new developed cites in Egypt, lacks the human scale [23]. Therefore, while they are planning the large and big cities only, they focus and consider the formation of external spaces, streets and squares, and the emphasis on the presence of distinctive landmarks. Such planning considerations contribute on CDs perception that leads to achieving the human scale in the city. Nevertheless, the reality informed the opposite vision as in Kharga city, which is one of the smallest in the cities of Egypt [27]. Although, New Vally and North Sinai governorates do not contain unplanned areas [27]. The author as one of Kharga residents observed that far away, not more than a decade, at that time, most of the residents of that suburban city discovered that they built their mosques on the wrong perception of the direction of the *Qiblah*, as they attributed the direction to the direction of the *Qiblah* of the first mosque established in the city which is called the *Almasjed Alkabeer*, and they depended on their personal perception. They fall in this mistake because of they were believing that any person does not miss the perception of CDs in a small city like Kharga. Thus, they used to determine the direction of the *Qiblah* without

tools when constructing a new mosque. Accordingly, they attribute the direction of the *Qiblah* to the new mosque in the city using personal perception, depending on the placement on the directions of the streets from *Almasjed Alkabeer*. Therefore, those mosques did not achieve the expected responsive internal environment for the worshipers, which is the content of the mosque [28]. The perception depends on the environment, maps' function and the type of the tools used to recognize the map [29]. Nowadays, many modern devices are used to determine directions. However, such devices are sometimes considered inappropriate, especially in a city where residents must determine these directions in many locations. For example, Farmers need to percept the direction of the *Qiblah* in their farms instead of moving to the city to pray, taking the words of the Messenger of God (PBUH) "*The earth has been made for me as a Masjed and a purifier*" [30]. Additionally, this awareness of perception of the CDs is needed by those who visit the city for the first time for the ease of navigation between its different sites, relying on simplified maps or verbal descriptions of the city's residents. Therefore, it is essential to consider the perception of the four CDs in the design of a city's street network, regardless of its size and presence of modern devices that help in this.

This research aims to examine the street network of Kharga City from the point of view of "prospect and refuge" theory; determine the achievement of perception of CDs and needed safety for human-scale feeling. Furthermore, the research studied the effect of streets' different patterns and shapes on achieving the city's human scale by perceiving the CDs in any location within the city. The author attempts to deduce the patterns and shapes that achieve the intended perception of the directions, which could ascribe to the innate senses of the people or with the correct placement of a true direction. The suitable design of the street network will help achieve the city's human scale. Then the residents will enjoy all the advantages of this human-scale city, such as achieving social cohesion, feeling comfortable and safe, shortening the time in moving from one place to another, and containing the city in a correct mental map of both its residents and pioneers.

2. Method

This paper discusses the case of Kharga City for three reasons; The author is a resident of the city; Changing the direction of *Qiblah* at all mosques of the city indicated that there was a real problem that needed investigation; and the third is that the paths or main streets in Kharga City have no

systematic layout configuration. There is lack specific direction of the streets, with various curves existing along the same street, and no existing landmarks on the streets' paths. Its streets' network pattern has gird structure within the neighborhoods, but there are main roads connecting the neighborhoods which are not grid structure. Accordingly, people cannot recognize the CDs or acquire them attributed to previously known directions, such as the direction of the *Qiblah* acquired knowledge in the home or workplace. Kharga City features seven major public buildings located along the main roads. Those buildings are used in the questionnaire as landmarks that are expected to be commonly known and their directions are easily recognized. The paper follows the inferential statistics approach for a sample of the residents in Kharga City as one of the cities directly affected by the problem. To achieve the aim, the paper adopted a survey, measuring a set of factors that are supposed to affect the inability of the community members to maintain awareness of the CDs while moving from one site to another. It then tried to prove these hypotheses through statistical analysis of the results of the different parts of the questionnaire. Following sections explained the survey detailed procedures:

2.1. Characteristics of the population

The population of the New Valley Governorate is 262,226 persons, of which about 48.2 % are the urban population living in Farafra, Mut and Kharga cities [31]. These three cities are similar in terms of urban patterns, as they have a grid network structure. This research study focused on Kharga City because it is the main one, as it contains a percentage of more than 50 % of the urban population in the governorate.

2.2. Characteristics of the selected sample

To ensure the sample is representation of the population, it has been selected to include different gender, age, and level of education, through simple random selection. The sample was chosen with a size of 100 people, including males and females: with 73 % males and 27 % females. The sample was of different ages; 15 % below 16 years of age, 18% between 16 to 25 years, 52 % between 25 to 50 years, and 15 % after 50 years. It was also diversified in terms of the level of education in a way that covers all groups; 9 % read and write, 42 % had intermediate technical education, 49 % university education.

2.3. Design of the questionnaire

The questionnaire was designed to achieve its goal. So, it was divided into four parts in addition to the respondents' bio-educational data which are included in the beaning of the questionnaire to determine the type of respondents in terms of gender, age, and education level, as these variables are supposed to affect the ability of the people to recognize the CDs. The first part of the questionnaire contains eleven questions; seven of them designed with 'Yes' or 'No' answers, to measure the respondents' ability to determine the CDs in the locations familiar to them. The remaining four questions measure extent of the respondents' conviction of the importance of the issue, the reasons for this problem, and the method he/she used to avoid that problem.

The second part contains eight pairs of questions in which the respondents answered with the help of the author; they were about determining the direction of the street at sixteen locations, with every two locations having same direction of streets. Figure 1. shows the sixteen locations, indicated on the city map. The author moved together with the respondents within these sixteen locations, during which the respondent informed the street direction at each location by choosing an answer from among nine options. The choices are the original and the secondary directions, in addition to the option, "I do not know". This part aimed to measure the effect of different curves in the street network, on the perception of the CDs.

The third part contained seven questions that the respondents answered using their imagination of the street network in the city. Each question was to determine the direction of the main facade of one of the seven commonly known buildings in the city. Figure 2. shows the correct directions of those main facades on the city map. This part basically examined how the mental map of the city is firmly established in the respondents' minds. In addition, it measured the effect of the street network pattern on changing the concept of the CDs in the mental map of the respondents.

The fourth part required the respondents to draw a map of a specific path in the city from memory. This part measured the effect of the street network's pattern and shape on distorting the respondents' mental map, which lead to the loss of some critical landmarks locations and the

inability to maintain awareness of the CDs while moving from one place to another. Figure 3. shows the map of the path to be drawn in this part of the questionnaire.
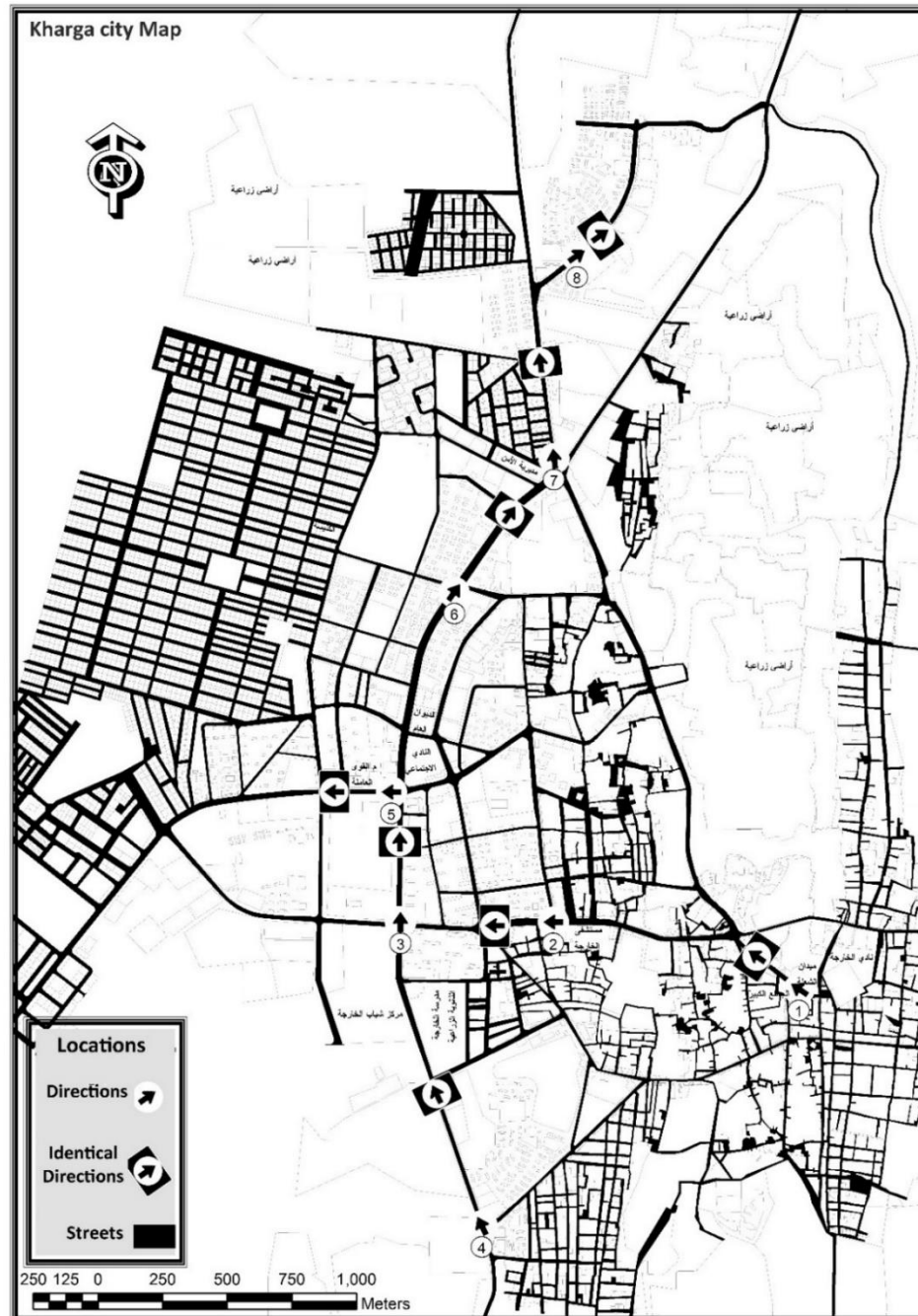
Figure 1. Locations and directions used in part 2 of the questionnaire

Note: The numbers inside the circles refer to the original locations' numbers in the questionnaire, while the locations with identical direction are indicated without numbers in the above map.

Source: prepared by the author, base map: [32]
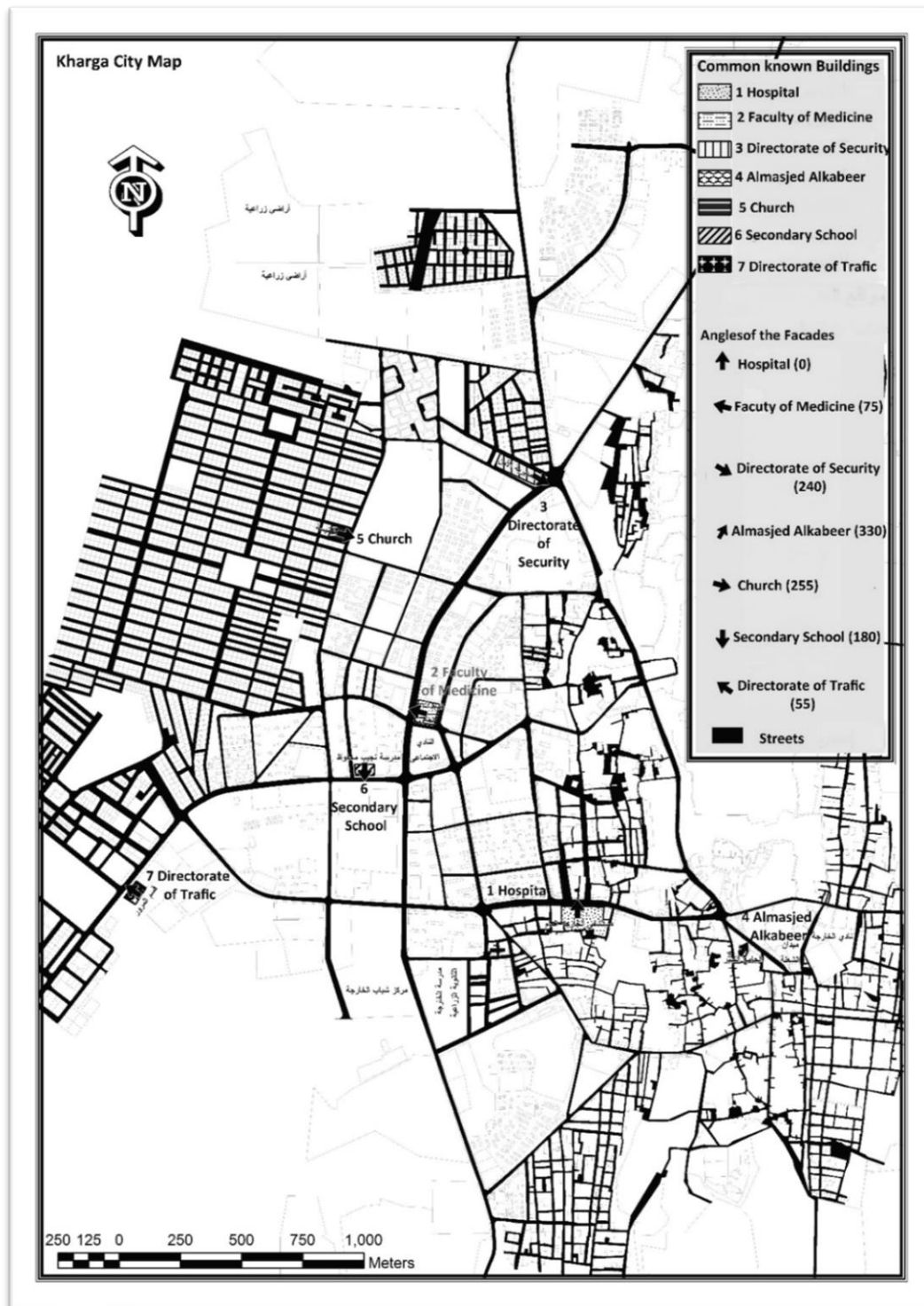
Figure 2. Locations used in part 3 of the questionnaire

The arrows indicate to direction of the facades of the buildings mentioned in the questionnaire, according to the order shown in the map key.

Source: prepared by the author, base map: [32]

Figure 3. A map showing the path to be drawn in the fourth part of the questionnaire

Source: prepared by the author, base map: [32]
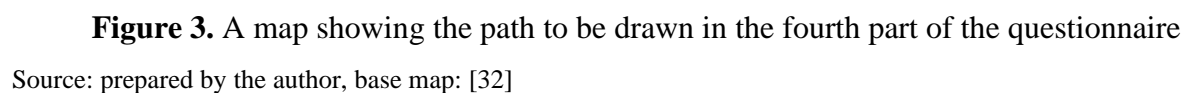
2.4. Questionnaire sample validation

The sample was tested by checking the answers to the sixth, eighth and nineth questions mentioned in Table 3. The three questions asked about the ability to recognize the CDs anywhere within the city, the home, and the workplace respectively. The forms with contradicting answers to those three questions were neglected, meaning that the respondent who answered 'Yes' for all the three questions was considered valid response, but who provided different answers for the three questions is considered invalid response. Out of the 100 respondents' answers, 99 answers for those three questions were constant, and considered valid responses, whereas only one respondent's answers were not constant, hence considered invalid. Thus, the sample size became 99 respondents.

3. Results and Discussion

3.1. Analysis of the results of the first part of questionnaire

Through the results of the first part, it is clear that the entire community represented in the selected sample confirms that the ability to recognize the CDs is very significant, confirming the research's importance and scope. It is also clear that the degree of this importance varies from one person to another. However, the majority considered it of great importance, and is evident in Table 1. As for the ability of the survey respondents to identify the CDs in their homes, 98.6 % of the males believed that they recognize them in their homes, while the percentage decreased to 87.5 % in their workplaces. The majority of females also believed that they recognize these directions in their homes and workplaces, but with a lesser percentage than the percentage of males. Perhaps this greater confidence in males' case is because the males wander more than females in the city streets. The elderly believed in their ability to identify CDs more than the young, in both locations of houses and workplaces, as the ratio was around 75 %:100 %, young to elders. Another reason might be that elders had longer experience in walking around the city than the young. As for the level of education, those who just can read and write believed that they were 100 % aware of the CDs in their homes and workplaces. That confidence of the elderly might have been due to their reliance on the direction of shade and sunlight to determine the CDs. Only 83.3% of the educated with average education believed they knew the CDs in their homes and workplaces. As for the

highly educated, they were more confident in their ability to determine CDs in their homes than in their workplaces. This result is evident from Table 2. in responses to Q4 and Q5.

Table 1. Responses to Q1 (importance of perception of CDs), Q2 (level of perception of the CDs)

Respondents' Category		Q1: Is it important for a person to be able to recognize the CDs by himself?			Q2: What is the significant level of the perception of the CDs?		
		Answers	Number	%	Answers	Number	%
Gender	Male	Yes	72	100	High	63	87.50
		No	0	0	Medium	9	12.50
		I don't know	0	0	I don't know	0	0
	Female	Yes	27	100	High	18	66
		No	0	0	Medium	9	34
		I don't know	0	0	I don't know	0	0
Age	Under 16	Yes	12	100	High	6	50
		No	0	0	Medium	6	50
		I don't know	0	0	I don't know	0	0
	16:25	Yes	21	100	High	18	85.70
		No	0	0	Medium	3	14.30
		I don't know	0	0	I don't know	0	0
	25:50:00	Yes	51	100	High	45	88
		No	0	0	Medium	6	12
		I don't know	0	0	I don't know	0	0
	More than 50	Yes	15	100	High	12	80
		No	0	0	Medium	3	20
		I don't know	0	0	I don't know	0	0
Education level	Beginner	Yes	9	100	High	6	66
		No	0	0	Medium	3	34
		I don't know	0	0	I don't know	0	0
	Medium	Yes	36	100	High	27	75
		No	0	0	Medium	9	25
		I don't know	0	0	I don't know	0	0
	High	Yes	54	100	High	48	89
		No	0	0	Medium	6	11
		I don't know	0	0	I don't know	0	0

54.2 % of the males believe that they can recognize the CDs themselves anywhere in the city, while on the other hand, this percentage of females decreased to 11.2 %. This decline may be because females do not go to all areas of the city, unlike males, who can roam in all areas for work, visits or picnics. As for the age or age factor, confidence in knowing the original direction anywhere in the city increased with age, except for the age group between 16-25, which outperformed the largest group by 15.9 %. As for the level of education, it did not register a particular proportion, as confidence increased at the lowest level, followed by the university level, and then the intermediate level. This difference is due to the elderly - who are also low-educated - relying on the shade and the direction of the sun's rays in determining the CDs.

Table 2. Responses to Q3, Q4, and Q5 the significancy's reasons & ability to recognize the CDs in house and workplace respectively

Respondents' Category		Q3: What is the significancy reason of perception of the CDs?			Q4: Do you recognize the CDs in your house?			Q5: Do you recognize the CDs in your workplace?		
		Ans.*	Number	%	Ans.	Number	%	Ans	Number	%
Gender	Male	1	30	42	Yes	71	98	Yes	63	88
		2	15	21						
		3	24	33	No	1	1	No	9	13
		4	3	4						
	Female	1	12	45	Yes	26	96	Yes	21	78
		2	9	34						
		3	6	22	No	1	4	No	6	22
		4	0	0						
Age	Under 16	1	3	25	Yes	9	75	Yes	9	75
		2	3	25						
		3	3	25	No	3	25	No	3	25
		4	3	25						
	16:25	1	6	29	Yes	18	86	Yes	15	71
		2	12	57						
		3	3	15	No	3	14	No	6	29
		4	0	0						
	25 - 50	1	9	18	Yes	51	100	Yes	48	94
		2	6	12						
		3	36	71	No	0	0	No	3	6
		4	0	0						
	More than 50	1	3	20	Yes	15	100	Yes	12	80
		2	3	20						
		3	9	60	No	0	0	No	3	20
		4	0	0						
Education level	Beginner	1	3	33	Yes	9	100	Yes	9	100
		2	0	0						
		3	6	67	No	0	0	No	0	0
		4	0	0						
	Medium	1	6	17	Yes	30	83	Yes	30	83
		2	6	17						
		3	21	58	No	6	17	No	6	17
		4	3	9						
	High	1	12	22	Yes	54	100	Yes	45	83
		2	18	33						
		3	24	44	No	0	0	No	9	17
		4	0	0						

*1 wander in the city without guidance, 2 Sense of familiarity in any location in the city, 3 possibility of determining the direction of the *Qiblah*, 4 Don't know

The above result is evident from Table 3. in responses to Q6. Regarding the method of perception of the CDs, responses to Q7 in Table 3. indicate to no one use the distinctive landmarks; majority

of males use direction of the sun and time, and 20.8 % of males use their own perception; minority of females use their own perception, while 44.4 % of females rely on other people, and 44.4 % of females use direction of the sun and time.

Table 3. Responses to Q6, Q7, and Q8 & Q9

Respondents' Category		Q6: Do you recognize the CDs anywhere of the city?			Q7: How you determine the CDs?			Q8/Q9: Are you able to determine the *Qiblah* Direction in your home/workplace?		
		Ans	Number	%	Ans*	Number	%	Ans	Number	%
Gender	Male	Yes	39	54.2	1	15	20.8	Yes	72	100
		No	3	4.2	2	12	16.7			
		Some	30	41.6	3	45	62.5	No	0	0
					4	0	0.0			
	Female	Yes	3	11.2	1	3	11.2	Yes	27	100
		No	12	44.4	2	12	44.4			
		Some	12	44.4	3	12	44.4	No	0	0
					4	0	0.0			
Age	Under 16	Yes	0	0.0	1	3	25.0	Yes	12	100
		No	6	50.0	2	3	25.0			
		Some	6	50.0	3	6	50.0	No	0	0
					4	0	0.0			
	16:25	Yes	12	57.1	1	6	28.6	Yes	21	100
		No	3	14.3	2	6	28.6			
		Some	6	28.6	3	9	42.8	No	0	0
					4	0	0.0			
	25 - 50	Yes	21	41.2	1	6	11.8	Yes	51	100
		No	9	17.6	2	15	29.4			
		Some	21	41.2	3	30	58.8	No	0	0
					4	0	0.0			
	More than 50	Yes	9	60.0	1	3	20.0	Yes	15	100
		No	0	0.0	2	0	0.0			
		Some	6	40.0	3	12	80.0	No	0	0
					4	0	0.0			
Education level	Beginner	Yes	6	66.7	1	3	33.4	Yes	9	100
		No	0	0.0	2	0	0.0			
		Some	3	33.3	3	6	66.6	No	0	0
					4	0	0.0			
	Medium	Yes	12	33.3	1	6	16.6	Yes	36	100
		No	6	16.7	2	9	25.0			
		Some	18	50.0	3	18	50.0	No	0	0
					4	3	8.4			
	High	Yes	24	44.4	1	6	11.1	Yes	54	100
		No	9	16.7	2	15	27.8			
		Some	21	38.9	3	33	61.1	No	0	0
					4	0	0.0			

*1 = on your own perception. 2 = by asking others. 3 = by the position of the sun and the time. 4 = by distinctive landmarks

Thus, when it comes to gender, males are more independents. The age does not show specific trend, so it does not affect the used method of perception of the CDs.

Table 4. Responses to Q10 and Q11

Respondents' Category		Q10: Are you able to determine the *Qiblah* direction anywhere of the city?			Q11: What is the reason of inability of perception of the CDs?		
		Answers	Number	%	Answers	Number	%
Gender	Male	Yes	39	54.2	Buildings are high	3	4.2
		No	33	45.8	City is large	3	4.2
					Street curvatures	66	91.6
	Female	Yes	9	33.3	Buildings are high	3	11.1
		No	18	66.7	City is large	0	0.0
					Street curvatures	24	88.9
Age	Under 16	Yes	3	25.0	Buildings are high	0	0.0
		No	9	75.0	City is large	3	25.0
					Street curvatures	9	75.0
	16:25	Yes	12	57.1	Buildings are high	0	0.0
		No	9	42.9	City is large	0	0.0
					Street curvatures	21	100.0
	25 - 50	Yes	27	52.9	Buildings are high	3	5.9
		No	24	47.1	City is large	0	0.0
					Street curvatures	48	94.1
	More than 50	Yes	6	40.0	Buildings are high	0	0.0
		No	9	60.0	City is large	3	20.0
					Street curvatures	12	80.0
Education level	Beginner	Yes	9	100.0	Buildings are high	0	0.0
		No	0	0.0	City is large	0	0.0
					Street curvatures	9	100.0
	Medium	Yes	15	41.7	Buildings are high	3	8.3
		No	21	58.3	City is large	3	8.3
					Street curvatures	30	83.4
	High	Yes	24	44.4	Buildings are high	0	0
		No	30	55.6	City is large	3	5.60
					Street curvatures	51	94.40

The level of education has adverse effect on the independency to recognize the CDs. 100 % of respondents believed that they could determine the direction of the *Qiblah* in their homes and workplaces, as shown in Table 3. in responses to Q8 and Q9. As for determining the direction of the *Qiblah* at any location in the city, the absolute percentage in the affirmative decreased to lower percentages, reaching 33.3 % for females, as shown in Table 4. in responses to Q10. From the above, it is clear that the absolute percentage of the ability to determine the direction of the *Qiblah* in homes and workplaces is an acquired knowledge and not a personal perception since they know the direction of the *Qiblah* by obtaining the knowledge. This result proves the validity of the research hypothesis as the shape of the street network in the city under study does not achieve the human scale. Moreover, the street network of Kharga city does not achieve maintaining knowledge of directions, even those attributed to previously known directions, such as the direction of the *Qiblah* acquired at home or workplace, and also as any original direction acquired for its conformity with the direction of a particular street or a public building in the city. This is due to three reasons, and the effect of each of them differs according to each segment of the respondents.

Although the respondents believe in three reasons for their lack of awareness of the CDs, the most likely reason is the random curves in the street directions, and this was confirmed by most of all the respondents' segments, as shown in responses to Q11 in Table 4.

3.2. Analysis of the results of the second part of questionnaire:

It is clear from Table 5. that gender affects the perception of the original direction, as males outperform females in the total number of correct answers in determining the direction in the eight sites and their alternatives, with a difference of 8 %. This outperforming may be due to the frequent wandering of males in the city streets, especially dismounting without riding. It is also clear that age directly affects the awareness of CDs, as adults outperform younger ones by a significant difference of 33.5 % between the oldest and youngest age group. Also, the level of education directly affects the awareness of CDs, but except for the "reads and writes" segment, this is due to the dependence of this segment on the shade and the direction of the sun's rays because they are all elderly. This method does not depend on young people or older people, but they depend on drawing and storing the mental map of the city and retrieving information from it when required.

Table 5. Responses to Q12:Q27* (sixteen questions in the second part the questionnaire)

Respondents' Category		Site	1		2		3		4		5		6		7		8	
		Q	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Gender	Male	True	12	13	45	48	63	60	18	18	42	48	15	18	15	12	21	21
		FALSE	60	12	27	24	9	12	54	54	30	24	57	54	57	60	51	51
	Female	True	0	60	18	18	21	21	0	3	18	18	6	3	3	3	3	3
		FALSE	27	0	9	9	6	6	27	24	9	9	21	24	24	24	24	24
Age	Under 16	True	3	27	3	3	6	6	0	0	6	6	0	0	0	0	0	0
		FALSE	9	3	9	9	6	6	12	12	6	6	12	12	12	12	12	12
	16 - 25	True	0	9	6	9	18	15	6	6	12	15	6	6	6	3	9	9
		FALSE	21	0	15	12	3	6	15	15	9	6	15	15	15	18	9	9
	25 - 50	True	3	21	39	39	45	45	9	9	36	39	9	9	6	6	12	12
		FALSE	48	3	12	12	6	6	42	42	15	12	42	42	45	45	39	39
	> 50	True	6	48	15	15	15	15	6	6	6	6	6	6	6	6	3	3
		FALSE	9	6	0	0	0	0	9	9	9	9	9	9	9	9	12	12
Education level	Beginner	True	3	9	9	9	9	9	6	6	3	3	3	3	3	3	3	3
		FALSE	6	3	0	0	0	0	3	3	6	6	6	6	6	6	6	6
	Medium	True	3	6	18	21	21	21	9	9	15	18	6	9	3	3	9	9
		FALSE	33	3	18	15	15	15	27	27	21	18	30	27	33	33	27	27
	High	True	6	33	36	36	54	51	6	6	42	45	12	9	12	9	12	12
		FALSE	48	6	18	18	0	3	48	48	12	9	42	45	42	45	42	42

*The questions asking to determine the CDs in eight locations and another eight identical locations to the first eight as mentioned in Figure 1.

It is also clear that the shape of the street network affects the perception of the CDs and the ability to maintain this perception. The evidence proving this statement mentioned above is increasing the percentage of correct answers in all segments of the respondents, perceiving the direction with the straight path, and this percentage decreased in perceiving the direction with rotation at a right angle. It decreased more in the perception of direction with rotation with a curve. This result also proves the research hypothesis by not achieving the human scale and realizing the CDs due to the random curves in the city streets; the lack of a specific texture followed in the street network design. It is worth noting that although it is a condition of road design that is preferred to be aligned with the natural change of the site's topography [33]. These random curves do not follow any topography; therefore, there is no need to resort to them in this city.

3.3. Analysis of the results of the third part of questionnaire

The results of the third part show that the compatibility of streets' directions with the street network pattern's homogeneity helps achieve the city's human scale. Such compatibility simplifies people's mental map and helps them draw and store it easily in the human mind, which leads to the realization of all directions anywhere in the city, thus achieving the city's human scale. This result is evident through the increase in the percentages and numbers of all the respondents' segments who identified the correct directions of the building facades whose direction is compatible with the CDs from those of the incompatible buildings, through Table 6.

Table 6. Responses to Q28-Q34 (seven questions in the third part of the questionnaire)

Respondents' Category		Building on Figure 2.	Hospital	Faculty of Medicine	Directorate of Security	Aljamee Alkabeer	Church	Secondary school	Directorate of traffic
		correct answers	N	NW	SE	NE	SE	S	NW
		Question	28	29	30	31	32	33	34
Gender	Male	TRUE	60	6	6	9	0	51	18
		FALSE	12	66	66	63	72	21	54
	Female	TRUE	21	0	3	3	0	21	3
		FALSE	6	27	24	24	27	6	27
Age	Under 16	TRUE	0	3	0	0	0	3	0
		FALSE	12	9	12	12	12	9	12
	16:25	TRUE	18	3	0	0	0	15	3
		FALSE	3	18	21	21	21	6	18
	25:50	TRUE	51	0	3	12	0	42	12
		FALSE	0	51	48	39	51	9	39
	> 50	TRUE	12	0	3	0	0	12	6
		FALSE	3	15	12	15	15	3	9
Education level	Beginner	TRUE	9	0	0	0	0	9	0
		FALSE	0	9	9	9	9	0	9
	Medium	TRUE	21	6	3	3	0	36	3
		FALSE	15	30	33	33	36	0	33
	High	TRUE	54	0	6	9	0	45	18
		FALSE	0	54	48	45	54	9	36

3.1. Analysis of the results of the fourth part of questionnaire

Through the results of the fourth part in Figure 4. all the respondents' segments could not monitor the random curves in the path and did not draw the path correctly. Therefore, it is difficult to draw a mental map of similar cities, which leads to the loss of the city's human scale and the loss of maintaining awareness of the CDs.
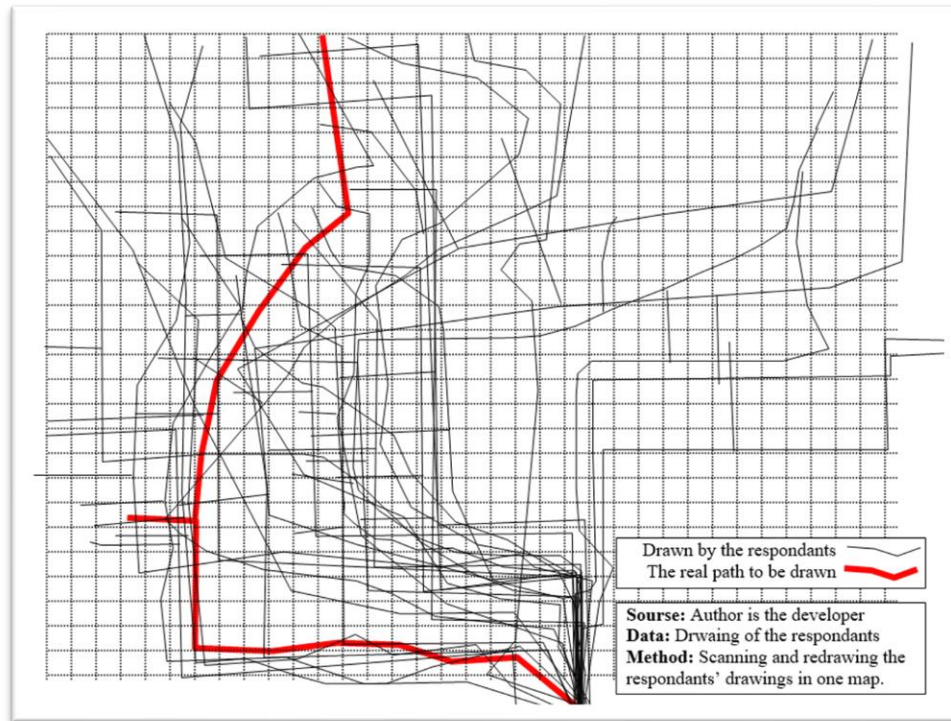

Figure 4. The mental map of the respondents for of one path

4. Conclusion

A city that has human scale provides a feeling of safety and comfort for residents while strolling around the city streets. Perceiving the CDs anywhere without electronic devices is one of the most important factors to achieve the human scale in a city. The significance of the CDs perception anywhere in the city is highly appreciated by the city residents. The ability to recognize the CDs and accordingly, the *Qiblah* direction, depends on several factors, including human factors (age, gender, education level) and urban factors (City size, City area, Heights of Buildings, Buildings Orientation, Street Orientation, and Streets pattern). A person roaming a city that has various street intersections, angles, and streets curvature, has obstacles to maintain knowledge of the CDs. The

typical configuration of the street network easily supports the CDs perception. Streets' network of Kharga City, mainly the main streets connecting the neighborhoods contribute in losing perception of the CDs anywhere, even though such directions are known in interrelated locations.

It is important to be able to determine the direction of the *Qiblah* relative to any original direction, in addition to the ease of navigating the city and the ease of verbal description of the different addresses.

The author recommends to urban planners that aim to achieve human scale in a city, to consider the following

1- Design street network in typical configuration to enable all people to recognize the CDs anywhere in the city.

2- Avoid random curvature of street paths, and the street network should be designed with a homogeneous texture.

3- The orthogonal grid pattern should be followed mainly in the design of the street network, as it is considered one of the best patterns that results in human scale of a city, at the same time according awareness of the CDs in any location in the city.

4- Further study for applying the notion of "prospect and refuge" to provide the pedestrians and drivers with proper perception of all parts of street edges, landmarks, and skyline.

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