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ENHANCING PEDESTRIAN FLOW IN PUBLIC SPACE THROUGH USER SEGREGATION

Ali Sedki
Assistant professor, Faculty of Architecture - Design & Built Environment, Beirut Arab University, Lebanon,
ayassine@bau.edu.lb

Farah Iaali
M. Arch. Student, Faculty of Architecture - Design & Built Environment, Beirut Arab University, Lebanon,
iaalifarah@gmail.com

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ENHANCING PEDESTRIAN FLOW IN PUBLIC SPACE THROUGH USER SEGREGATION

Abstract

This paper attempts to improve the pedestrian flow in the public space of Yaacoub El-Labban Square in El-Mina district, Triopoli, North Lebanon. The new understanding of urban planning aimed to promoting pedestrian movement while restricting the unnecessary use of vehicles. It is presumed that the presence or absence of vehicular activity can affect the motion and mobility of pedestrians in a certain zone. Consequently, this study, first, run a Space Syntax interpretation using DepthMap analyses for the chosen case study in order to understand how pedestrian movement can be promoted and increased through user segregation, and, additionally, restrictive use of the square by vehicular users. Measurements were conducted using DepthMap to analyze the current human activity pattern in the square, then, verifying this analysis by operating an on-field observation for the current state and utilizing a movement tracing map to prove the different street choices by vehicular users. These results will be compared to the Space Syntax visualization analyses using DepthMap at the current state in order to prove its reliability concerning its predictions for future modifications and how they would affect the user movements.

Keywords

Public space, Space syntax, DepthMap, Pedestrian flow, User segregation

1. INTRODUCTION

The main challenge of today's public spaces is to make sure they are being used. Nowadays, most public spaces and piazzas that should be used as desirable spaces for events and social activities but, surprisingly, they do not become effective or actively used. It is vital to explore the factors most likely to create benefitted public spaces in an effort to turn the underused urban voids into lively and utilized spaces for urban core activities (Velazco, 2010). The public place has now become a strictly nominative term, a soulless space, however, its function and dynamics can be restored (Hanafi et al., 2019). Public squares, a key attraction in cities around the world, not only bring economic benefits, but also offer people a convenient place to gather for personal, cultural and political activities (PPS, 2010). Many factors like the condition of the location, the availability of stores, the presence of water and vegetation, the accessibility of the site, the good treatment of urban design and the possibility of having panoramic views increase the rate of use of the space. (Hanafi et al., 2019)

Many scholars investigated the relationship between the weather or thermal comfort of a space and the volume of pedestrians that using it, for example, one of these studies stated clearly that the pedestrian volume had a weather-related relationship. The study examined the effect of temperature, wind speed, season and the time of the day, as well as humidity and cloud cover. Results revealed that, statistically, the most significant factor influencing the pedestrian volume was the temperature and all other variables were not statistically significant amongst all observed weather characteristics (Shaaban & Muley, 2016). Likewise, other authors state that even without obvious visual signals such as shadings, trees or water features, perceived air temperature can differ in a space. Humans can accurately sense the difference in temperature even by 0.005 ° C by arm and less difference as well by forehead. Therefore, this perceived disparity can lead people to change path to a cooler place, or avoid passing through a certain space. (Melnikov, Krzhizhanovskaya, & Sloot, 2017).

Furthermore, several articles discussed the effect of including good street furniture in a public space on the presence and the flow of pedestrians. Villanúa (2009) in her article imposes on the fact that public spaces should be managed without barriers; that they should be naturally limited either by landscape or the surrounding buildings. Making the space dissolve subtly with the neighborhood is a must. A good pedestrian experience is determined by factors such as the choice of pavement materials, urban furniture and the layout of spatial lighting. In addition, in case of implemented green areas, vegetation that provide shading are highly effective. Relatedly, a group of researchers agreed that the lack of wind and sun protection and the lack of seating both indicate that such spaces are typically treated as front yards and do not accommodate any pedestrian activity. (Stephen et al., 1992)

Similarly, other articles studied the relationship between opening or spreading commercial activities like food kiosks, streets vendors and shops and the flow of people through a certain space. In a journal article named “Towards a High-Intensity Use of the Public Space of the Arid Cities” the author concluded that in order to increase the frequency of use of the public places of a city one has to offer trade by adding shops compatible with the purpose of the place to meet the needs of users - newspaper kiosks, gifts, flowers, drinks, dairy, etc. They defined the commercial place as a venue for trade, social activities, meetings and holidays (Hanafi et al., 2019). Similarly, Cohen in his research “Memorable Streets Draw More Pedestrians” stated that a group of researchers assessed 20 street landscape features - such as historic buildings, long sightlines, street furniture, commercial services, building colors - and conducted pedestrians count on 588 blocks in New York City to try and determine what attracts pedestrians to a certain space. They settled that for boosting foot traffic, successful activities were street coffee shops and parks. Those elements fit into the imageability category - how memorable the place is (Cohen, 2015). In addition, El-Fayoumi in his paper about Street Vendors’ Roles in Main Squares Utilization claims that street vendors play a major role in the use of squares in any city, which has a direct connection with the implementation of the concepts of strategic urbanism. Knowing that various types of street vendors are available in terms of size, type of products, income, allocation, and flexibility, the author concludes that street vendors’ movement has a direct relationship with space activities, weather, and pedestrians as well as customers flow inside a space (El-Fayoumi, 2016).

Finally, some scholars studied the user-conflict matter in public spaces by exploring the significance of certain human, context and design-specific factors affecting pedestrian and driver perceptions of Public space. Public space is an approach to enhancing streets and areas where both

pedestrians and cars are present, with more pedestrian-related configurations and amenities that enable drivers to feel their priority has been reduced or removed. This provides a more pedestrian-friendly environment than traditional street configurations, based on greater distinction between pedestrians and cars, while at the same time creating confusion that makes drivers more concerned with their atmosphere, leading to lower vehicle speeds and improved safety. The results suggest that, under conditions that ensure that their presence is visible to other road users, pedestrians feel most comfortable in public spaces. These conditions include; low vehicle traffic, moderate pedestrian traffic, good lighting, and pedestrian-only facilities. In comparison, the presence of many people and, in particular, children and the elderly, makes drivers feel uncomfortable and, therefore, increases their alertness (Kaparias et al., 2012). In the best of researcher's knowledge, no further papers discussed the user conflict problem in public spaces were found.

After an on-site survey of the current situation in Yaacoub El-Labban square in the heart of the old El-Mina city, many problems were spotted. These vary between lack of vegetation, lack of street furniture, illegal parking of cars killing the square's social aspect, closed shops as well as low human activity. Talking to some locals, mainly shops owners in the square, many stated that the main problem is the low pedestrian movement around the site. This latter problem, leads to no economic activity therefore the closing down of many retail shops and eventually the bad economic situation of people living in this area.

The main objective of the in-hand study is to increase the flow of pedestrians through the chosen site in order to revive the square socially and increase the probability of people buying from the existing retail shops, therefore recover the socio-economical state of the area. The pedestrian - vehicular conflict in the square has significant effect on the overall use of it. Presumably, if we prevent the vehicular access through the site, the volume and flow of pedestrians will increase.

2. METHODS AND TOOLS

Space syntax approach was followed throughout this research. Space syntax is a science-based, human-focused approach which investigates the relationship between spatial structure and a number of cultural, economic and environmental phenomena. Professor Bill Hillier, Professor Julienne Hanson and colleagues at The Bartlett University College of London, pioneered the space syntax in the 1970s (Penn, 2008). Hillier and Hanson established the theory of space syntax. They created different representations for the components of space, furthermore, they drew maps of these components and, most importantly, the relationships of the components with each other. The most commonly used representation in the space syntax group is the axial map. The actual derivation of the axial map, as we will see, is quite complicated, but it simply includes drawing a series of lines through the open space of the plan.

This paper is developed on two key ideas which are, first, the effect of preventing vehicular access completely on the current pedestrian flow and movement and, second, confirming the accuracy and the validity of Space Syntax approach (DepthMap tool) predictions in the case study. The measurements of the first part was conducted by using DepthMap to analyze the current human activity pattern in the square; how they would move, how they adapt and will be affected by the prevention of vehicular access around the square. The software would help us to trace people's movement before and after transforming the square into a pedestrian only zone. The second part would happen through an on-field observation of the vehicular choice then comparing it with the current results of DepthMap.

2.1 Integration – DepthMap Validity

From literature review, Hillier and Hanson (1993) created an interesting twist to the established theory. They generated a graph using the axial lines themselves as nodes, so that each line was considered to be connected to the others that it intersected. From this graph, they calculated how well' integrated' each line was in relation to all the others in the graph, that is, they calculated a measure of the average number of steps taken to get from one line to another in the axial map. The integration of axial lines is of particular interest to researchers as it corresponds well with the number of pedestrians found walking along the axial line. 'Integration' is a measure which has seen much mention in the space syntax literature. The measure is essentially a normalized version of the

mean depth, and it is important because it has been found to correlate well with pedestrian movement 'gate' counts, as remarked in the introduction (Hillier, et al., 1993).

2.2 Measurements

The metric choice is of more interest to researchers, that is, the number of times a location is being come across a path from origin to destination. This is not yet registered, as the calculations is becoming extremely complicated, however, it appears that the metric option could potentially give some indication of pedestrian movements only in the segment graphs.

3. APPLICATION AND RESULTS

The research was applied in four consequent phases as following:

3.1 DepthMap analyses

To interpret and predict the density of pedestrian movement, syntactic analysis is performed as a first approach in the study area. The initial step of the analysis includes archival records based on an existing AutoCAD map of Tripoli and El-Mina old city, brought from the municipality of El-Mina, the street network was drawn and saved as a DXF file. (Map A, fig1) This file was imported into DepthMap and converted into an axial map. In this section, every axis in the map represents an existing street. (Map B, fig1).

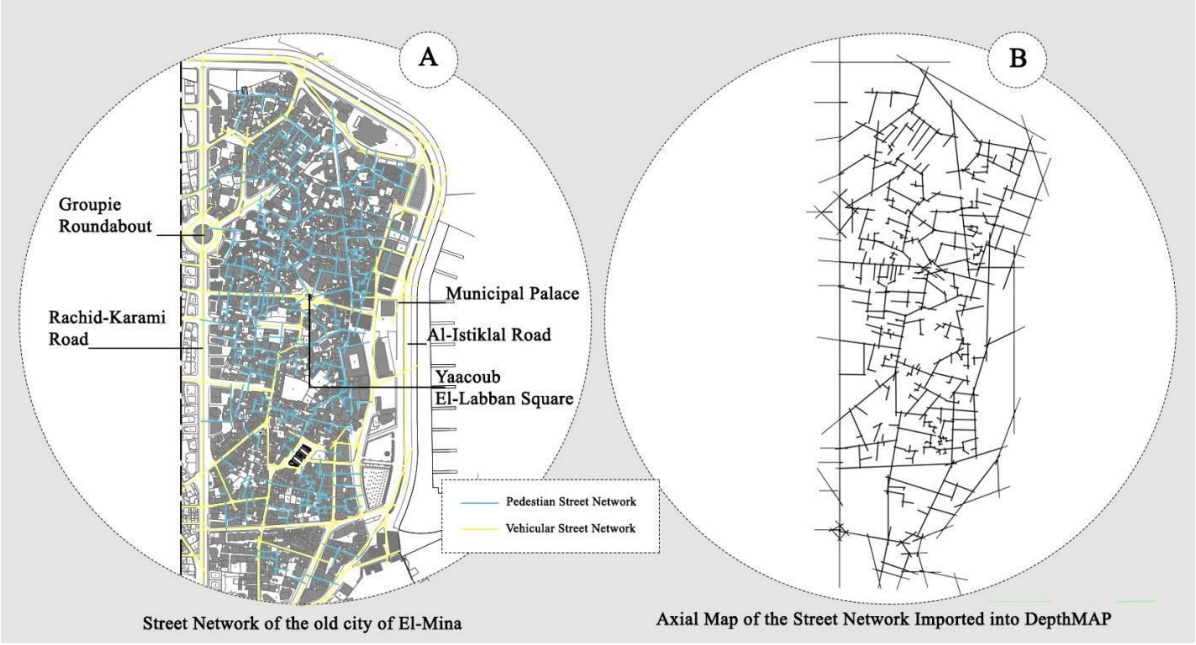

Figure 1: Transforming a CAD Map into a Street Network Axial Map
Reference: Photographed by the author

3.2 Map reading tips

First of all, in order to read and understand a space-syntax map two things need to be cleared out. The radiuses; R=Rn is the radius used for vehicular movements, as it takes into study the whole map therefore all the possible streets, however, R=200/400 are radiuses used to calculate the possibilities for pedestrian movements, as pedestrians are able to cross about 200 to 400m on foot as a general rule – a 5 to 10 mins walk. Second, the colors; the integration or choice level is visualized on the maps with colors ranging from blue to red, the least integrated/chosen to the most integrated/chosen respectively.

The colors represent the integration/choice levels from 0 to 6, blue to red. An integrated road or street is considered to be a "to movement" street which people are most likely to head to. The different variables measured by the DepthMap software include the measure of connectivity; which implies the number of streets connected to a certain street, the measure of integration; which indicates the distance between a certain street and all the other ones in relation to the number of streets in the complete system, in other words, how a street is integrated or central comparing to the

overall network. Finally, the measure of choice; which shows how often a street is being passed through based on calculation of the shortest paths in the network (Turner, 2004).

3.3 Before and after solution testing

At the beginning, the two different streets networks were split from the original map in order to have two maps; one of them represents the pedestrian street network only (Map A, fig2) and the other one represents the vehicular street network only (Map C, fig.2). Both maps in their current state are as they are in the real life. Afterwards, both maps have been modified after closing the square for pedestrians exclusively in order to compare its effect on the integration level for both types of movements. This happened by including the square in the pedestrian street network axial map (Map B, fig 2) and removing it -the square- from the vehicular street network axial map (Map D, fig 2)

Pedestrian Analysis, According to DepthMap, (Map A, fig.2) shows that the most integrated pedestrian streets are the ones in the old city of El-Mina above Yaacoub el Labban Square; these are the streets that people are most likely going to head-to on a daily basis in the normal conditions.

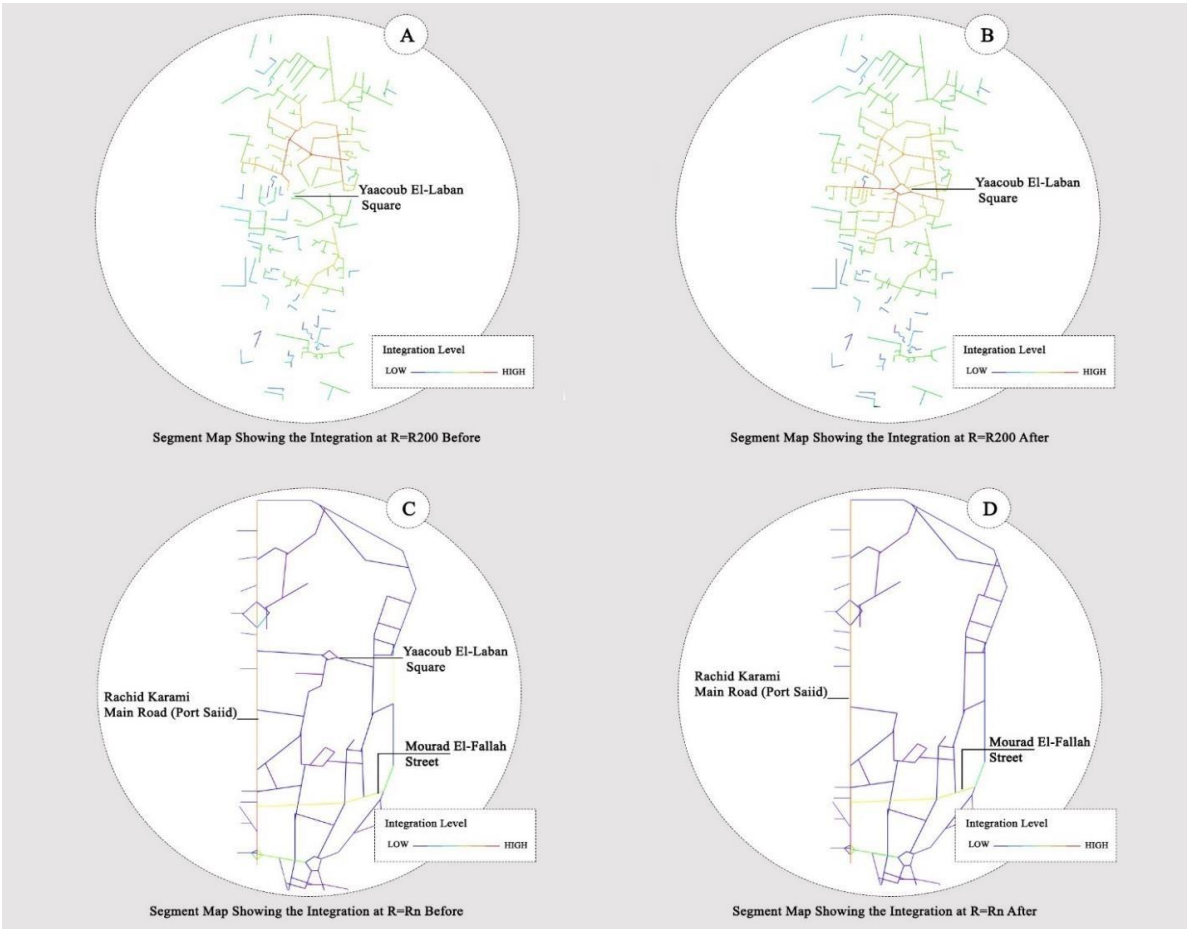

Figure 2: Integration level before and after closing the square on pedestrian street network and vehicular network separately. Reference: by the author

However, after closing down the square for pedestrian use exclusively, the integration level in the square and the streets around it jumped from 0, 1 and 2, to a level 5 and 6.

Vehicular Analysis were conducted considering the square closed to be only for pedestrian, however, in order to take such a decision, it is important to prove that it would not cause any traffic problem or affect the vehicular use of certain streets. To test that, the square and its adjacent streets were removed from the vehicular street network and segment analysis were done. Comparing before and after situation, the presence and absence of the square and its surroundings from the vehicular street network did not affect the predicted movements by users. According to DepthMap analysis (Map C-D (fig 2)), the most integrated vehicular street at R=Rn currently is Rachid-Karami Road, publicly known as Port Saiid Road (Integration level=6 - in Red). Additionally, in second place, the Mourad El-Fallah Street at the bottom of the map, linking the sea-side road to Rachid-

Karami Road (Integration level=5 in Orange) both before and after removing the square and the adjacent streets with no change in the integration level of any other existing road. In other words, both remain a favorable destination for car-users.

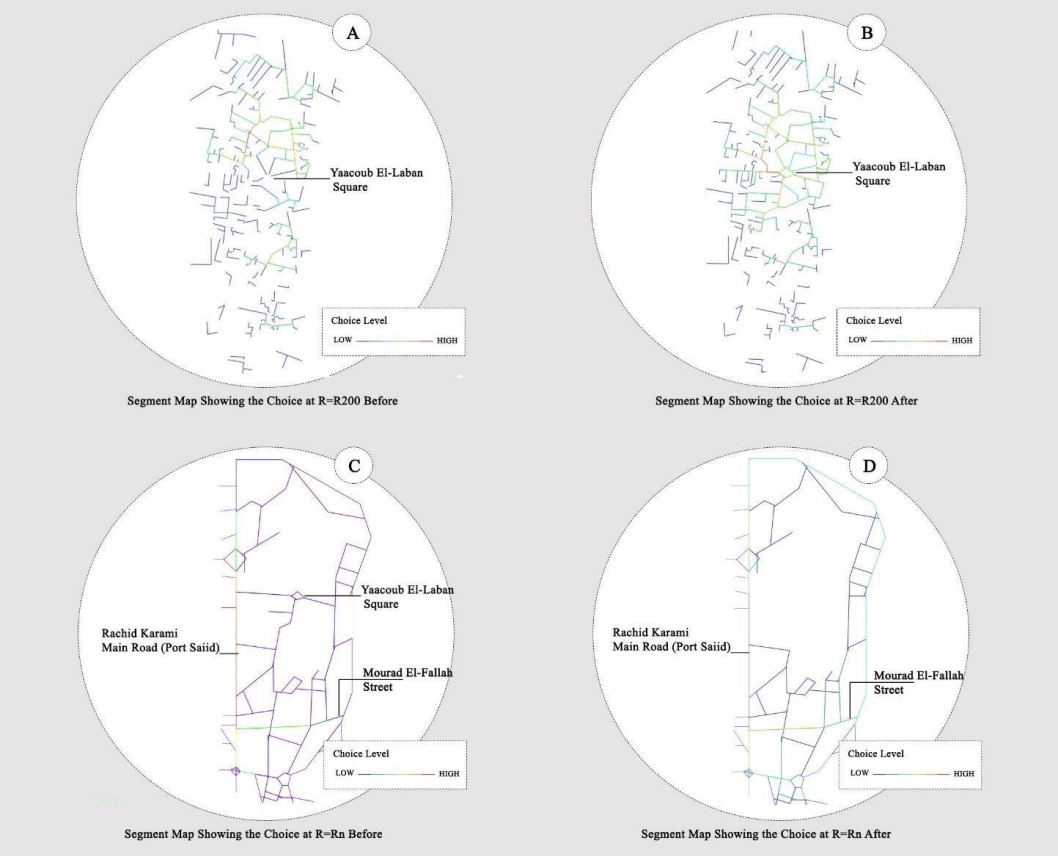

Figure 3: Choice Level Before and After Closing the Square on Pedestrians and Vehicular Street Networks respectively. Reference: by the author

Similarly, the axial map that represents the pedestrian street network only (Map A, fig3) and the other one with the vehicular street network only (Map C, fig.3) both are in their current state as they are in the real life. Both have been then modified after closing the square for pedestrians exclusively in order to compare the effect on the choice level for both types of movements. This happened by including the square in the pedestrian street network axial map (Map B, fig 3) and removing it from the vehicular street network axial map (Map D, fig 3).

Pedestrian Analysis - The segment map analysis run on the before map (Map A, fig3) show that the most chosen street by pedestrians (R=R200) is one not leading to Yaacoub El-Labban square. On the contrary, the street with the highest choice level (level=6) is branching from the old city of El-Mina and leading to different other secondary roads. However, after closing down the square as suggested, the most chosen street shifts to one of Yaacoub El-Labban's main streets.

Vehicular Analysis, Once again, proves that closing the square would not affect the current traffic movement and congestion in El-Mina city, the same analysis has been done on a radius (R=Rn) to measure the choice level; the street that car-users are most likely going to use in order to reach a destination. The before (Map C, fig 3) and after (Map D, fig 3) both show that the road with the highest choice level remains Rachid-Karami Street (Port-Saiid), however, the choice level of the sea-side road increases from level 0 to level 2 when closing down the square; in other words, the traffic flow on the sea-side road might increase a bit after closing the square but there is no predicted causing of a new over congested road – No new Red-Colored road spotted.

3.4 Observation - Testing the accuracy of DepthMap

As remarked in the introduction of their paper, Hillier and his colleagues have found that the integration level correlates well with pedestrian movement 'gate' counts at R=200. (Hillier, et al., 1993). It was decided in the study to test the accuracy of DepthMap on the vehicular choice results previously stated in (Map C, fig 3). In order to do that, the main observation points (gates) were chosen carefully and they are; the gate that splits the two well-known roads; Rachid Karami (Port Said) and Mourad El-Fallah (Gate A, fig.4), the gate where the point that splits Mourad El-Fallah Road (Gate B, fig.4) and the gate where the beginning of Rachid-Karami Road (Port-Saiid) exists (Gate C, fig.4). Afterwards, in order to track vehicular choices between these roads, the movement tracing map was drawn to show them as a result of the observation.

Analysis for the Car-users coming from Tripoli heading towards any area in El-Mina, in addition to people coming from Al-Shiraa Roundabout (Gate C), shows that they are both choosing Rachid-Karami Road as their main way towards their destination. In addition, vehicle users coming from the sea-side road through Mourad El-Fallah (Gate B) are splitting into two; either going towards Rachid-Karami road, or towards Al-Shiraa Roundabout. It is important to state that, unlike Rachid Karami Road, Mourad El-Fallah is a one-way Road. Finally, people are leaving El-Mina toward Tripoli also using Rachid-Karami road as their first option and main link towards any destination. The previous observation confirms the validity of DepthMap results, however, some doubts are still there concerning Mourad El-Fallah road being the second most chosen road; since, by observation, it had a choice level particularly similar to any other road, taking into consideration that it is a one-way road only.

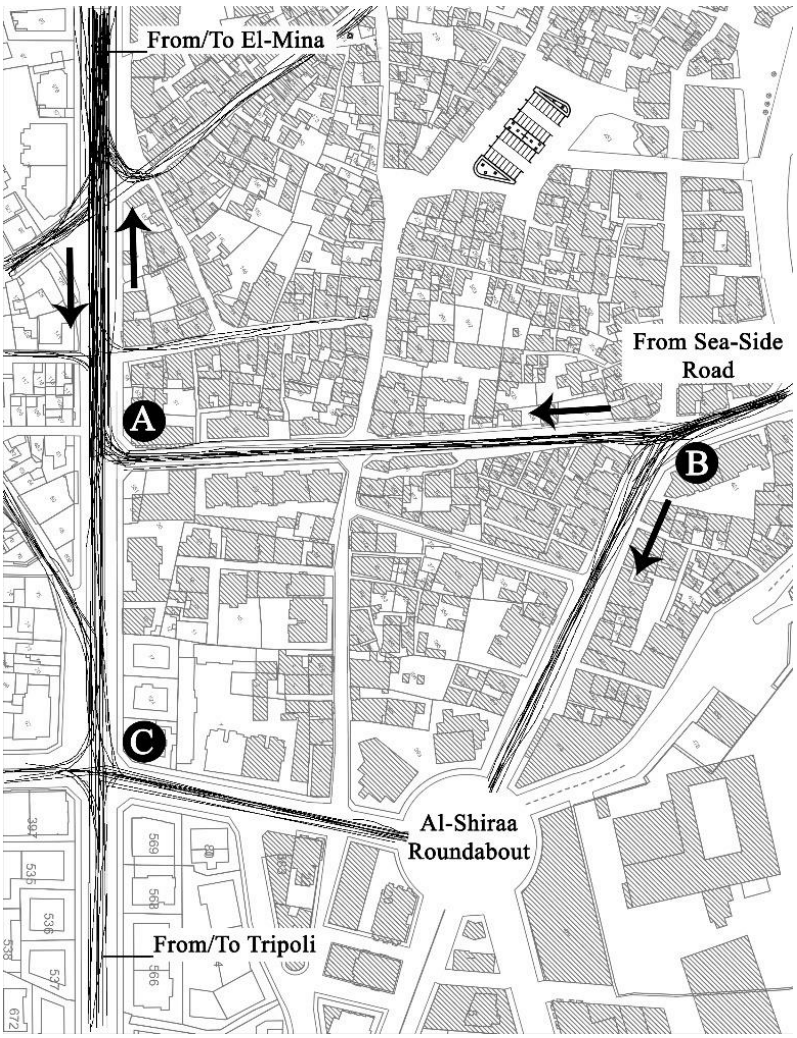

Figure 4: Movement Tracing Map of Vehicular Movement and Street Choices.
Reference: by the author

4. CONCLUSIONS

The paper examined the syntactic properties of an urban space of Yaacoub Ellabban Square in El-Mina city, Tripoli, North Lebanon to reliably predict the densities of pedestrian movement in order to increase the pedestrian flow and social activities in the square. DepthMap analyses shows that the most integrated pedestrian streets are the ones in the old city of El-Mina above Yaacoub el Labban Square, these are the streets that people are most likely going to use on a daily basis in the normal conditions. However, after closing down the square for pedestrian use exclusively, the integration level in the square and the streets around increased from 0, 1 and 2, to a level 5 and 6.

The pedestrian integration results of space-syntax (DepthMap Analyses) have been previously proven to be accurate in literature, however, space syntax approach perceives pedestrian movement densities in specific streets and areas due to the fact that pedestrian movement is being studied solely within the framework of the syntactic properties and layout of the urban environment, without taking into account other spatial factors influencing pedestrian choices such as land-use. Furthermore, the question about how accurate the results may be for vehicular users remains unanswered, as space-syntax does not take into account the direction of existing roads (one-way or two-ways). The results of the on-field observation and tracing map show that there might be doubtful results regarding the choice of streets (according to DepthMap) by car-users due to the fact that one of them is a one-way road and doesn't really confine much traffic as expected. Further research includes adding a weighting factor on the existing roads according to land-uses that attract pedestrians and comparing how it would affect the stated results.

REFERENCES

- Cohen, J. (2015). Memorable Streets Draw More Pedestrians. New York: Next City.
- El-Fayoumi, M. (2016). Street Vendors Roles In Main Squares Untilization as a Type of Tactical Urbanism Application in G.C.R. Green Urbanism, 153-163.
- Hanafi, A., et al. (2019). Towards a High-Intensity Use of the Public Space of the Arid Cities. Energy Procedia 157, 443-456.
- Hillier, B., et al. (1993). Natural movement: or configuration and attraction in urban pedestrian movement. Environment and Planning 20, 29–66.
- Kaparias, L., et al. (2012). Analysing the perceptions of pedestrians and drivers to shared space. Transportation Research Part F: Traffic Psychology and Behaviour, 297-310.
- Ma, X., et al. (2019). Study on Outdoor Thermal Comfort of the Commercial Pedestrian Block in Hot-Summer and Cold-Winter Region of Southern China. Tourism Management, 186-205.
- Melnikov, V., et al. (2017). Models of Pedestrian Adaptive Behaviour in Hot Weather. International Conference on Computational Science, 12-14.
- Penn, A. (2008). Space Syntax Network. Retrieved from Space Syntax: http://www.spacesyntax.net/
- PPS. (2010). The Re-Emergence of The Public Square. New York: Project for Public Spaces.
- Samadi, Z., et al. (2014). Experiencing Urban through On-Street Activity. Environmental Settings in the Era of Urban Regeneration, 25-27.
- Sengel, T., et al. (2015). Tourists' Approach to Local Food. World Conference on Technology, Innovation and Entrepreneurship, 429 – 437.
- Shaaban, K., & Muley, D. (2016). Investigation of Weather Impacts on Pedestrian Volumes. 6th Transport Research Arena, 18-21.
- Stephen, C., et al. (1992). Public Space. Environment and Behaviour Series.
- Turner, A. (2004). Depthmap 4 - A Researcher's Handbook. London: Barlett School of Graduate Studies, UCL.
- Velazco, T. K. (2010). Full and Void: Activating Public Space in the Contemporary City. Electronic Thesis or Dissertation.
- Villanúa, M. A. (2009). The Public Space as Forgotten Element and Generator of the City Crisis.