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The impact of parking on traffic congestion in Zawiya City in Libya

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Abstract
The car parks problem is a global one. This research paper studies car parks facilities and their distribution throughout the city of Zawiya, the size of each car park area, and the suitability of their distribution to the services available in the city. It also examines the relationship between car parks and traffic congestion in the city, seeking the best solutions to traffic congestion, and exploring smart car parks solutions to find the nearest available space as quickly as possible. Furthermore, it identifies areas in the city that need car parks, the area required to accommodate the number of cars in the city, and how to construct car parks facilities as quickly, cost-effectively, and to the highest quality standards.

Keywords: *Car Parks - Traffic jams - streets*

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I. Introduction

The world is witnessing population growth, especially in Arab and Islamic countries, where growth is accelerating. The reason for this is religious beliefs and the culture of society that encourages population growth. Libya is also one of the countries with rapid population growth. The increase in population results in an increase in urban growth and urban expansion in Libya. With the decrease in car prices, large numbers of imported cars enter the country. As a result of the increase in population and the increase in the number of cars in Libyan cities, congestion and traffic jams occur. To avoid traffic jams, car parks spaces must be provided so that they do not impede the flow of traffic.

The city of Zawiya suffers from a severe shortage of car parks spaces. Cars are forced to use the main and side streets within the city due to the lack of sufficient car parks areas. This has a negative financial and psychological impact on drivers, as they need time and effort to find a parking spot, leading to increased fuel consumption, wasted time, and a bad mood. Drivers may even be forced to park far from their destination.

Research problem
Like other Libyan cities, Zawiya suffers from a severe shortage of car parks spaces, forcing drivers to park their cars on the sides of main, secondary, and service streets, which reduces the area of these streets and prevents them from functioning properly, resulting in traffic jams in the city's streets.

Research hypothesis
1- The car parks spaces currently available in the city of Zawiya are insufficient to accommodate the cars of the city's residents, employees, and merchants coming from outside the city.
2- The lack of car parks spaces is one of the causes of traffic congestion and gridlock.

Research objectives
The aim of this research is to provide car parks spaces in the city of Zawiya that operate with the latest technologies and accommodate all cars in order to eliminate traffic congestion within the city.

Research Importance
The importance of this research lies in reducing traffic congestion, shortening the time spent searching for car parks spaces, and eliminating the stress and frustration experienced by drivers due to lengthy searches for car parks.

II. Research Methodology

The researcher initially followed a desk study methodology by reviewing previous studies on the topic. He then moved to a laboratory study, using ArcGIS Pro software and its maps to determine the distribution of car parks spaces within the city. Finally, he conducted fieldwork to verify the parking spaces, confirm their locations, and correct any distortions that appeared in the satellite images.

Parking challenges in Zawiya city

Like all Libyan cities, Zawiya suffers from traffic congestion, especially during peak hours. This increases the pressure on car parks spaces and causes parking problems, which is one of the most significant challenges facing parking facilities.

1- Street congestion due to cars: Most city residents own private cars, and it's rare to find someone over 18 who doesn't own a car. This has led to a large number of cars in the city, and even half of these cars being on the city streets causes a problem.
2- Low gasoline prices: Libya has some of the cheapest gasoline prices in the world, leading to a lack of concern for fuel consumption. When driving, drivers don't think about the fuel level, and cars are used for the most trivial reasons. Most drivers use their cars even for short trips that don't require a car, such as going to grocery stores, bakeries, or nearby schools that are only 200 or 300 meters from home. Many drivers drive aimlessly, simply to alleviate boredom
3- Workers and employees from outside the city have flocked to Zawiya, as it is considered the capital of the northwestern region of Libya. Therefore, workers and employees who live outside the city but whose work is within its boundaries are drawn to it. In addition, citizens needing to complete administrative procedures that can only be obtained within Zawiya are also arriving, which increases the pressure on the city and its various facilities.
4- Random parking is a major problem in the city, which suffers from a severe shortage of parking spaces, both in terms of number and size. Car Parks areas are few and small, and residents need to park their cars to complete their errands. Shop owners, workers, employees, and shoppers also need parking spaces for extended periods to finish their business. When there are no designated car parks areas, residents are forced to park anywhere they can, disregarding the problems that arise from this behavior because they have no alternative. This only exacerbates the problem.
5- The lack of passenger buses within the city, which would greatly alleviate congestion, as buses can transport a large number of people on a single trip, means that each person who is supposed to ride on the bus will use a private car. If cars move with the number of passengers on the bus instead of one bus, it causes severe traffic congestion within the city.
6- The high prices of land within the city limits have led to a reduction in the services provided by the plot of land designated for housing, as residents mostly use the plot of land for housing only, without considering a small plot for parking the car. Each house has more than one car, so the cars are parked in the street, and this occupies a space in the street area and causes confusion and traffic jams in the street.
7- Car prices in Libya have decreased, making it one of the cheapest countries in the world for cars. This is due to low customs duties, low taxes, and support from the Central Bank of Libya in the form of hard currency for car import agencies. These factors have led to lower car prices in Libya, enabling a large segment of the Libyan population to own cars, with many Libyan families owning more than one Car
8- The ease of car import and licensing procedures means that every Libyan citizen has the right to import any number of cars without intermediary companies or monopolies from any party, which has led to a large number of cars in Libya.

Car Parks in Zawiya city

There are several types of car parks facilities found in cities worldwide (multi-story, underground, and surface parking). In Zawiya, there are no multi-story or underground parking garages. The only available type is surface parking, meaning parking at ground level. All parking is free; citizens do not pay any fees to park their cars. These parking areas are available for use seven days a week, with no specific days designated for their use. The researcher used satellite imagery and ArcGIS Pro software to identify the large parking areas in the city and measure their size to compare the available parking with the city's needs. The following table lists the names and capacities of the parking areas.

Table No. (1) car Parks spaces in Zawiya city and their capacity

	Name	Area/ms
1	hospital1	3732
2	hospital2	773
3	hospita3	1494
4	almothlth	2099
5	administrative complex	3827
6	engineering1	1266
7	engineering2	1216
8	Park	1920
9	Republic bank	5153
10	Licensing	911
11	Security Directorate	1252
12	Dila	7234
	total	30,877

The table shows that the largest car parks area in the city is the Dila parking lot. In reality, the Dila car parks lot is not a single lot but rather a group of small car parks areas, as it is located within a complex of residential buildings containing 1,000 apartments. There are also unpaved car parks areas in Dila, which remain dirt lots. The total area of paved car parks is 7,234 square meters, and these car parks areas are scattered among the residential buildings, making them widespread in the northern part of the city. The second largest car park lot is that of the Republic Bank, covering 5,153 square meters. This lot is located west of the bank, in the south of the city, north of Jamal Abdel Nasser Street. The third largest car parks lot is that of the hospital, totaling 5999 square meters. The northern car park lot is 773 square meters, the southern car park lot is 3,732 square meters, and the central car park lot is 1,494 square meters. These lots are located within the boundaries of Al-Zawiya Teaching Hospital, southeast of the city. Fourth on the list is the car park lot of the former administrative complex, which was removed, and the car park lot remains. It is located east of the city's central park with an area of 3827 square meters on the southern side of Jamal Abdel Nasser Street. Fifth on the list is the car parks lot of the College of Engineering with an area of 2482 square meters, where the northern car park lot has an area of 1216 square meters, while the southern car park lot has an area of 1266 square meters, and they are located within the boundaries of the College of Engineering north of the city. Then in sixth place is the almuthalth car parks lot, which is a group of old residential buildings containing a group of small car parks lots with a total area of 2099 square meters. These residential buildings are located in the southeast of the city between Jamal Abdel Nasser Street and the main road leading to the capital city of Tripoli. In seventh place is the Park car park lot, which is located in the middle of the city, almost west of Omar Al-Mukhtar Street, and its area is about 1920 square meters. In eighth place is the Security Directorate car park lot, which is located in the middle of the city, almost north of Jamal Abdel Nasser Street, with an area of about 1252 square meters. After that, in ninth place is the Licensing car park lot, which is a parking lot for the police and car licensing, and it is located in the southeast of the city near the Triangle buildings, and its area is about 911 square meters.

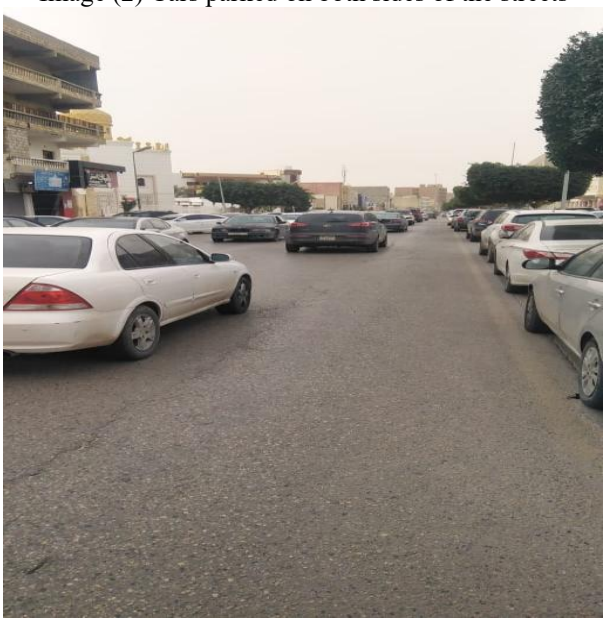
Image (1) Car parks lot of Al-Zawiya Hospital



Source: Researcher's own work

Satellite images show that the total area of car parks spaces in the city of Zawiya is approximately 30,877 square meters in a city with a population of 158,836 and 34,080 families. Given that the car ownership rate in Libya is 463 cars per 1,000 people, the highest rate in the Arab world and Africa due to the lack of public transportation in most Libyan cities and villages, owning a car is a necessity. From this, we conclude that there are approximately 73,541 cars in the city of Zawiya. In Libya, the dimensions for a single park space are calculated as 2.5 meters wide and 5 meters long, meaning the net area for parking one car is 12.5 square meters. However, the space for parking, turning, and movement in parking spaces must be taken into account, so the area allocated for one car is 18-22 square meters, with an average of 20 square meters per car. This means that the city of Zawiya needs 1,470,820 square meters of parking space, of which only 30,877 square meters are currently available. The available space represents only 2% of the city's needs. Those unfamiliar with the city might consider this percentage exaggerated, but in reality, the city suffers greatly from a lack of parking. Image (1) shows parking spaces on both sides of Jamal Abdel Nasser Street, the city's main thoroughfare, causing significant traffic congestion.

Image (2) Cars parked on both sides of the streets



Source: Researcher's photograph

III. Results

1- Wasting time

As a result of the lack of car parks spaces with sufficient space, drivers waste time searching for a place to park their car. Often, if a place to park the car is found, it is far from the place to reach, which forces drivers to walk a long distance, and this also wastes time.

2- Environmental Pollution

As a result of the time spent searching for a parking space, fuel consumption and exhaust fumes are released into the air, along with engine oil vapors. Frequent braking also causes friction between the brake components, resulting in dust and debris falling onto the ground, thus polluting the soil.

3- Fuel consumption

In the search for a parking spot, cars consume quantities of gasoline that could be avoided if parking spaces were available. Cars vary in fuel consumption depending on the type, date of manufacture, and engine power. Some types do not consume much fuel, while others consume a lot. In all cases, the search process consumes quantities of fuel that are unnecessary.

4- Traffic congestion

As a result of the lack of sufficient space for parking cars, drivers are forced to park their cars on the sides of main and secondary streets, which leads to a reduction in the area of these streets and causes congestion and traffic jams.

5- Lack of public transportation

The city lacks public transportation options such as buses, which has led to an increase in the number of cars within the city.

Recommendations

1- Increasing the size of parking spaces in the city
2- Distributing parking spaces fairly and appropriately throughout the city
3- Using multi-story parking garages to accommodate the largest number of cars
4- Using modern technology that shows drivers available parking spaces using mobile applications
5- Use public transportation such as buses to reduce the number of cars moving within the city

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