Intelligent Transportation Strategy to Promote Sustainable Urban Transport Tools (Case Study of the City of Najaf - the Republic of Iraq)

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Abstract. Upgrading the level of transportation and its services is an urgent necessity, especially since the development of cities is measured by the most important indicators of development in the urban field, and among the most important of these indicators is what is known as smart transport, as it means smart transportation using modern technologies of communication and information technology to face many challenges in various areas of transportation, And the elimination of all obstacles that stand in the way towards achieving a smart urban environment in light of the lack of a clear urban policy to benefit from smart transportation applications and the absence of strong management of the concerned authorities, as the smart transportation strategy in the holy city of Najaf aims to improve many indicators of mobility and traffic movement in general by the year 2030, as it includes the introduction of smart transportation systems as one of the ideal solutions to traffic problems. Part of this strategy includes establishing an express metro network along the main roads of the city and down to the city centre, Also, following this strategy leads to raising the level of traffic safety, reducing carbon emissions, reducing the demand for parking, reducing the cost of transportation, as well as reducing the time of arrival to the city centre and the removal of traffic jams from the vital city centre.

1. Introduction

The transport sector is an important pillar of development plans, whether economic, social or political. It is one of the main axes for making cities more competitive and attractive for investment and providing job opportunities for their residents [1]. And the fact that the city of Najaf is one of the important religious cities in Iraq and a point of focus and departure for most religious events to other cities because of the religious sanctity it represents, represented by the presence of the shrine of Imam Ali Ibn Abi Talib, peace be upon him, this made it a center of attraction for the residents of different provinces, especially after the year 2003 [2]. Najaf city suffers from several problems in the transport sector and other traffic services, and among the most important of these problems are bottlenecks, traffic accidents and the pollution resulting from them, and this has caused great losses to society, especially on the human level, and the cause of these problems is due to several factors, including the lack of readiness and efficiency of the entire transportation system. It suffers from a lack of many laws, legislations, equipment, means and awareness [3]. Those problems that Najaf faces may not
differ from the problems experienced by major cities in various countries of the world. However, these countries took the initiative and some of them were able to develop and provide smart modern means of transportation and organize well-thought outlaws and legislations for transportation [4]. The march to find appropriate solutions to transportation problems in the city of Najaf has already started in the past few years, and despite this, successive administrations and governments have not yet been able to find final solutions to transportation problems within the city of Najaf, and this does not mean the failure of the efforts of some previous and current governments because some of these The solutions helped to some extent to solve some outstanding problems, as the increase in population growth has already contributed to the exacerbation of transportation problems [5]. Therefore, this research is concerned with finding a strategy that contributes to developing an initial vision for transportation within the holy city of Najaf to reach an intelligent, safe, efficient and comfortable transportation system that contributes to solving the traffic problems that the city suffers from, as well as one of the priorities of this strategy is the proposal to establish an express metro based on modern technology [6]. It links the old city center (the religious center) with residential neighborhoods, as well as the important and vital administrative government facilities in the city [7].

2. Goal, Tasks, Methods of Study
The goal of this work is to implement a smart transportation strategy that meets the needs and requirements of the Holy City of Najaf, as well as improving the quality of life within the framework of a sustainable and long-term vision based on smart transportation systems. As an initial vision for transportation within the holy city of Najaf was developed to reach a safe and effective intelligent transportation system to solve traffic problems, as the following tasks were adopted such as data collection and information to build a database for analysis and statistical modelling using geospatial systems (GIS), to determine the best paths for the proposed metro line As well as places to stop. As the method that will be adopted in this article is based on the analytical approach within the spatial information systems (GIS) by adopting the specific criteria for the urban form of the city.

3. Experimental Part
The city of Najaf is one of the most prominent cities in Iraq and the center of Najaf Governorate, located to the southwest of the capital Baghdad and about 160 km away from it. Its population is 1,221,248 according to 2011 statistics, as it is considered the fifth most populous city in Iraq [8]. The city of Najaf gained its importance as one of the important cities in Iraq due to the presence of the tomb of Imam Ali bin Abi Talib, peace be upon him, who was the first imam among Shiite Muslims, in addition to the presence of the Cemetery of the Valley of Peace, which is the largest cemetery in the world, so Najaf gained religious importance for tourists coming from inside Iraq or Those coming from outside Iraq to bless the shrine of Imam Ali Ibn Abi Talib, peace be upon him, and visit the dead in the Wadi Al-Salam cemetery. Administratively, the city of Najaf represents the administrative center of the governorate. Najaf is bordered to the east by the holy city of Kufa, about 10 km away, and it is also an important religious center for the presence of the shrine of Muslim Ibn Aqil, peace be upon him, as well as the great mosque of Kufa, in addition to some other religious places. Maps (1) shows the location of Najaf Governorate in Iraq, and the city of Najaf and its religious and urban center.
The application of smart transportation in the city of Najaf requires diagnosing traffic problems and the availability of a set of technologies. To determine the required technologies, it is necessary to determine the technical elements available in the city. A large part of the main transportation network in the city is equipped with surveillance cameras, so the rest of the city needs to be equipped with these technologies. Also, wired networks that cover parts of the city and wireless that cover the entire city can contribute to data transmission.

To implement the smart transportation structure for the city of Najaf, as shown in the table (1), most of the smart transportation applications must be applied, due to the traffic problems existing in the city of Najaf, and because of the high cost of technologies and the time required to implement these applications. Therefore, the priority of relying on some applications was determined based on their importance, as the highest priority of short term (1-3) years was given to applications that contribute to solving basic problems related to congestion, parking, and the level of pollution, and the middle priority (3-8) years It included applications that deal with solving immediate problems, such as automatic road closures and providing information on weather conditions and applications that partially contribute to solving problems such as automatic vehicle inspection and automated toll collection, as they were given the least priority of long-term (More than 8 years).

There are a set of stages to achieve the smart transportation strategy in the city, including:

- Data collection: It is the first step in the modelling process, and the results of this data are used to achieve traffic management, as accurate traffic meters and road network characteristics are necessary to build and calibrate a traffic simulation model, as this data includes the characteristics of the road network and traffic flows.
- Modelling and simulation: through which data are modelled, and charts showing the typical distribution of the transport are prepared.
- Determine the appropriate roads to cross, and the unsuitable roads, while suggesting alternative roads.
Table 1. The proposed smart transportation structure for the holy city of Najaf.

| Traffic problems        | Suggested applications of intelligent transportation systems | Suggested techniques                      |
|-------------------------|-------------------------------------------------------------|------------------------------------------|
| Traffic congestion      | Traffic management                                         | Data collection                         |
| Inadequate parking      | Parking management                                         | Data processing                         |
| The length of the emergency response time | Demand for Transportation Management | Control and transmission of information |
| High level of pollution | Enhance traffic safety                                      |                                          |
| Traffic accidents       | Reducing the level of pollution                             |                                          |
|                        | Automated examination of safety (measuring vehicle weight) |                                          |
|                        | Payment via E-payment System                               |                                          |
|                        | providing information on weather conditions                |                                          |
|                        | Automated road closures                                    |                                          |

Surveillance cameras
Devices of remote sensing
Electronic counters
Equipment for measuring the weight of the vehicle during the movement
Radar velocity measurement

Geographic Information Systems (GIS)
Telecommunication network
Indicative panels for drivers
Automated message signals
website
Information cabanas

4. Results and Findings
The goals of the proposed future strategy for the smart transportation system for the city of Najaf include the establishment of a high-speed metro network linking parts of the city with each other, as shown in the map (3). The distribution of the metro stops was based on the vital and influential sites as well as the central sites in the city. The pattern of clustering and spatial dispersion of these stations was measured based on the Multi-Distance Spatial Cluster Analysis in spatial information systems (GIS) according to the mathematical equation [11]:

The K-Function is given as:
\[ L(d) = \sqrt{\frac{A \sum_{i=1}^{n} \sum_{j=1, j \neq i}^{n} k_{i,j}}{\pi n(n-1)}} \]

The results for Distance Spatial Cluster Analysis-Multi were as shown in Table (2) and Figure (2).

Table 2. Results in Multi-Distance Spatial Cluster Analysis.

| OBJECT ID | Expected K | Observed K | Diff K  |
|-----------|------------|------------|---------|
| 1         | 334.35     | 191.26     | -143.09 |
| 2         | 668.70     | 604.82     | -63.88  |
| 3         | 1003.05    | 1018.06    | 15.01   |
| 4         | 1337.40    | 1426.99    | 89.59   |
| 5         | 1671.75    | 1728.41    | 56.66   |
| 6         | 2006.10    | 2103.86    | 97.76   |
| 7         | 2340.45    | 2431.84    | 91.39   |
| 8         | 2674.80    | 2695.79    | 21.00   |
| 9         | 3009.15    | 2983.49    | -25.65  |
| 10        | 3343.50    | 3236.39    | -107.11 |

Figure 2. Representation of the Multi-Distance Spatial Cluster Analysis indicators.
5. Conclusions
Interpreting unweighted K-function results According to the results in the table (2) and the figure (2), the (observed K) value is greater than the (expected K) value for a certain distance, so the distribution is more clumpy than the random distribution in that distance (analysis scale) and this It indicates that the distribution of spatial phenomena (stations) is compatible with the urban form of the city and achieves efficiency and fairness in the distribution of metro service stations.

6. Summary
The study deals with how to implement a clear future smart sustainable transportation strategy that takes upon itself to solve the growing urban transport problems in the holy city of Najaf within the short, medium and long term. Where the most of these problems are represented by traffic congestion, especially in major intersections, most of which are devoid of traffic signals, which reflects negatively on the increase and emergence of other problems that come in second places, such as traffic accidents and environmental pollution. In addition, the strategy includes the process of establishing and implementing an integrated metro system, which is one of the most important strategies planned for the development of urban transport in the city of Najaf, which will contribute effectively to solving multiple transportation problems, especially in the seasons of major religious visits, given that the city of Najaf enjoys a great religious sanctity. Among Shiite Muslims around the world. In addition, the process of establishing and implementing the metro system is considered a national project for the development of the city in tourism, social, economic and environmental terms.

Figure 3. Distribution of metro service stations in the city of Najaf.
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