Study the Importance of Intelligent Transportation Systems in Solving Congestion Problems within The City and Conservation of The Environment

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Abstract. Baghdad city suffer from the traffic jams problem. The lack of roads is accommodating the increase in transportation as well as the lack of the organization and healthy management. Meanwhile, traffic lights defect due to it may location near to the checkpoint which causes traffic jam and unusual delay. The transportation services depend on (private, taxi) cars which cause increase in traffic movement, energy consumption, emission of polluting gases for environment and the most important (first carbon oxide, nitrogen oxides, lead, carbon dioxide, suspended particles, oxides of sulfur). Thereby, this research will done determination the pollution rates induced from congestion in streets associated in the yard located near institute of technology / Baghdad. An account rate gases emitted from vehicles using regression equations de-pending on traffic size in streets, flow speed traffic movement, neighbouring building height, and afforestation density. The search reached to finding species and gasses rate which pollution the environment in comparison with international Health standards and benefit of the application Intelligent Transportation Systems (ITS) to reduce of the pollution ratio the resulting of traffic jams.

1. Introduction
The problem of traffic congestion is one of the most prominent traffic problems for many cities of Iraq. Increase the time of mobility and energy consumption as well as environmental problems of air pollution due to high levels of pollution, especially at peak hours due to the large traffic volume on the roads. Which has a high proportion of the composition of large vehicles "Heavy Truck", it leads to a kind of environmental pollution. These problems were solved by traditional methods, through the establishment of new ways or expansion of existing ways to reduce congestion, which gives a solution in the short term, negatively affect the environment, and attracts in-creasing traffic to the vehicle within cities.

The technical development that accompanied the twentieth century offers a range of opportunities to find appropriate solutions of these problems by organizing and planning traffic within the city. Using intelligent transport systems improve the living environment of the population inside the city. It reduces traffic congestion problems and reduces the time spent on trips, the energy consumption and the emission of polluting gases. Thus saving costs reflected as additional benefits to road users through
the overall improvement of the road network. As a result reduces the impact of pollution resulting from traffic problems.

Traffic congestion is a major negative impact on the city's population. The most prominent is the problem of environmental pollution of the city's air by external gases from vehicle exhausts [1]. The polluted air is thrown into the atmosphere. Meanwhile, the number of private vehicles is expected to 2.5 times over the next 30 years. So private vehicles will need 2.5 times the fuel currently used and will produce 2.5 times the current gas emissions [2].

The most important pollutants emitted from vehicle exhausts are carbon monoxide (CO), hydrocarbons and nitrogen oxides [3]. As well as, other contaminants such as carbon dioxide and particulate matter suspended in the air [4]. Cargo transport in 2007 caused about 800 million tons of CO2, which is about 3% of global emissions. The traffic share is estimated to be 79.5% of atmospheric emissions. The average car emission of CO2 is estimated at 197g/ km/person. On the other hand, the intensive exploitation of oil led to the consumption of 50% of the global reserves. Sustainable development in the field of transport has already taken into account the sustainability of transport-consuming resources in order to meet the transport policy most conducive to sustainable transport using ICT for the application of intelligent transport systems [5].

Intelligent transport systems are included traffic engineering, computer technologies and communications systems to achieve integration. There are many ways to improve traffic and road transport safety, including: road system, cycle paths, pedestrian paths, mass transit, rail systems and infrastructure for land transport systems (such as highways, streets, train stations, public transit stations, bridges and tunnels). Intelligent transportation systems reduced congestion and provide in time travel, in-crease safety, improve air quality, increase customer satisfaction and lower fuel consumption [6].

![Applications of intelligent transport systems within cities. An Illustration of ITS (photo credit: www.etsi.org)](image)

Figure 1. Applications of intelligent transport systems within cities. An Illustration of ITS (photo credit: www.etsi.org)

There are major benefits in improving transportation as intelligent transportation systems are implemented as follows:

Application of arterial road management systems is likely to reduce delays between 50% and 40% with the implementation of advanced information control systems [7]. The application of Advanced Information System (ATMS) reduced traffic stop-and-go to about 30% and reduced travel time by 13-45%. Highway management systems can reduce accidents by as much as 40%, increase capacity, and reduce travel times by up to 60%. Advanced Driver Information System (ADIS) is expected to reduce flight time (10-15%), which contributes to improved air quality. Transit management systems reduce travel times by up to 50% and increase reliability by 35%.

The CVO system has had an important impact on improving the efficiency of service for cargo carriers. Cargo management systems reduce the cost of motor vehicles by 35% with the
implementation of information systems for commercial vehicles and networks. Accident management system has a significant role in reducing accidents by (40%) [8]. AVLCAD traffic management reduces the operating cost by about 8.5% per vehicle per mile, 2.4% for the traveler's journey, and in Metro New York, the met-ro tickets recorded a profit of $70 million. The use of the Visacard system in Atlanta reduced the cost of cash payments by $3 million, increased income in New York City after the use of smart miter cards to $4 million, and in New Jersey, an increase of 12% (70%) of communication inquiries asked for information on roads through which the percentage of communications increased by (80%) [9]. Advanced driver in-formation system (ADIS) is expected to reduce flight time between (10-15%) [7]. The US Roads Administration reports estimated that the implementation of the intelligent transport system saved about 11000 people, reduced 440,000 injured and saved 22 billion dollars in 2010. In the field of energy and environment, (2.2 billion gallons) in 2000, and is expected to be about 6.5 billion gallons in 2010, in the United States of America (2003).

Baghdad suffers from severe traffic congestion, which has affected the environ-mental system of the city, especially with regard to pollution resulting from the exhaust of cars. The traffic congestion is more dangerous because of incomplete fuel combustion in vehicles, which generates pollutants (gas, suspended minutes, and heavy elements). The available database collects on traffic in roads and intersections in terms of traffic flow and reaching some planning indicators. The regression equations used to determin pollution rates due to congestion in the streets. Benefiting from the application of intelligent transport system (ITS) is leading to a significant reduction in the percentage of pollution, which results from congestion traffic.

In this reseach, the application of intelligent transport systems will contribute to solve the problem of environmental pollution resulting from traffic congestion in Baghdad city towards finding solutions. The sustainability of these solutions has through surveillance and tracking. The research was based on analyzing the traffic volumes in the streets of the study area. After conducting traffic surveys, the type of vehicles is determined, speed of vehicles, height of buildings, and afforestation rate to extract the levels of pollution resulting. Level of congestion and the percentage of pollution of the study area will reduce the traffic volumes. Resulting of the gases emitted from vehicles based on the indicators extracted to reduce the level of congestion through the study of intelligent transport experiences in the world.

2. Research Methodology
Transport has been plagued by several problems, notably as a result of internal migration, rapid population growth and increasing the proportion of private car usage. The most important problems of transport within cities are: the problem of bottlenecks, traffic accidents and pollution, which cause great losses. Planning in the area of improving transport and traffic requires the development of road and street networks (including tunnels, bridges, intersections, etc). The means of transport used the organization and planning of traffic within the city using smart systems for transport. The living environment of the population will improve within the city and alleviate the problems of overcrowding and accident risk. It also reduces travel time and improving security and reducing crime. Thus, the costs saved and general improvement of the road network within the cities. Consequently, the effects of pollution resulting from traffic problems have been reduced [10].

The data and information for these systems are obtained from road sensors, traffic reports, city maps and current plans as well as motorists, traffic men and researchers in this field [7]. In this study, the database includes ITS systems (drivers, Traffic men, researchers, sensors, traffic reports, city maps and roads). ITS systems are a number of subsystems
- Advanced Traffic Management Systems (ATMS)
- Advance Traveler information systems (ATIS)
- Advanced Vehicle Control Systems (AVCS)
- Vehicle Load Operation Systems Commercial Vehicle Operations (CVO)
- Advanced Public Transportation Systems (APTS)
- Advanced rural transport systems (ARTS) [11], [7].

The pollution permissible limits in the environment is exceeded the concentration of contaminants led to harm at human health [12]. Many countries had adopted some criteria as well as the standards
adopted by the World Health Organization (WHO) which call for concentrations of pollutants to be lower than specifications [13]. The following table illustrates some of the values and standards adopted in a number of countries, as well as those of the World Health Organization (WHO), which can be used to compare with the actual values of the extent to exceed the permissible limits of greenhouse gas pollution in the environment.

**Table 1. Emissions standards of some developed countries and WHO.**

| Emission type / Measurement period | Canada   | U.S.A   | W.H.O   |
|-----------------------------------|----------|---------|---------|
| Sulfur dioxide (SO₂)              |          |         |         |
| 24 hrs                            | 11ppm    | 13ppm   | 9ppm    |
| 1 hr                              | 34ppm    | 49ppm   | 26ppm   |
| Carbon monoxide (CO)              |          |         |         |
| 8 hrs                             | 13ppm    | 9ppm    | 9ppm    |
| 1 hr                              | 31ppm    | 35ppm   | 26ppm   |
| Nitrogen dioxide (NO₂)            |          |         |         |
| 24 hrs                            | 11ppm    | 5ppm    | 7.9ppm  |
| 1 hr                              | 21ppm    | (100Mg/m³)³ | 21ppm  |
| Particulate(2Hhr)                 | 120Mg/m³ | 260Mg/m³ | 120Mg/m³ |
| Lead (Pb)                         | 1.5Mg/m³ | 0.3 PPM  |         |

ppm: Part per million
³According to the British standard
Mg/m³ Micrograms per cubic meter

Practical scientific studies have reached a number of mathematical equations. The quantities of gases emitted in the street can be calculated, then compared to the pollution permissible limits to indicate the pollutants exceed these values or not. A British study, through the TRRL, has reached a number of equations by using regression models. Since pollutant concentration is variable depending on the volume of the traffic only as compared to the permissible values and indicate the pollutants exceed these values or not. These equations are:

Regression equations used to estimate vehicles emissions

\[ N = 46.9 - 0.036 T + 0.00004 T^2 \]  
\[ N: \text{Mg/m}^3 \text{ The rate of nitrogen dioxide Concentration NO} \]
\[ T: \text{A traffic volume for an hr} \]

\[ S = 9.94 + 0.022 V \]
\[ S: \text{Mg/m}^3 \text{ Smoke} \]
\[ V: \text{Total vehicles through 3 hrs} \]

\[ L = 0.000249 P + 0 \]
\[ L: \text{Mg/m}^3 \text{ Lead concentration rate} \]
\[ P: \text{Total vehicles through 3 hrs} \]

It is noted, these equations were based on traffic volume only. Therefore, other applications have been adopted additional variables of the environmental capacity. It has affected the concentration of pollutants such as road width, height of buildings on both sides and the density of afforestation [12].

\[ Y_{co} = 35.0897 + 0.659 X_1 - 0.379 X_2 + 0.412 X_3 - 0.593 X_4 \]
\[ Y_{co}: \text{Pmm/1hr Carbon monoxide CO} \]
\[ X_1: \text{Environmental traffic density, which can be calculated as follows} \]
X1 = \frac{V \times \% Pcu + \frac{1}{4}(\% Hv)}{\text{Average speed}}

V: Total volume of traffic on the street for one hour  
\% Pcu: The proportion of traffic combination of private cars  
\% Hv: The proportion of traffic combination of large and medium cars  
X2: The rate of street width  
X3: The height rate of buildings bordered the street  
X4: (0 or 1) the intensity of forestation

The second formula focuses on lead concentration as follows:

\[ Y_{pb} = 0.41 + 0.053X1 - 0.0108X2 + 0.104X3 - 0.876X4 \]  

\[ Y_{pb} \text{: mg/m}^3 \text{ Lead concentration rate (Pb)} \]

X1: ADT/1000 Average daily traffic  
X1 = ADT \times \% Pcu  
X2: The rate of street width  
X3: The height rate of buildings bordered the street  
X4: (0 or 1) the intensity of forestation

Closed-Circuit Television Station

CCTV system has been used as a primary means of monitoring traffic performance on the road network, especially at critical intersections. These tools can provide visual observation of happens at the road network [15]. The application of the video surveillance system is usually to manage the traffic signals, pedestrian areas or traffic areas, penalize use of bus area and illegal parking. The system will increase road safety, as well as reduce accidents, congestion, violations of traffic rules, vandalism and crime. As it reduces air pollution by tracking vehicles that enter illegally restricted traffic areas [16]. Roadside cameras can also be used [17]. As for CCTV, it has a fixed location. The cameras are permanently installed, either in the structures along the highway or using especially installed columns [18].

3. Practical Research

The data collection of the study area is selected. The study area was chosen the Prophet Al-Wass. It is located on the Rusafa side of the municipality of Karrada. This is the southeast part of the municipality of Karrada. One of the main roads to Middle Techniques University (Including the Institute of Tectology, the Technical Engineering College, Arts Institute, and Arts College) in Baghdad. This square is used to connect four main roads and serve the main road from the 54th Street to the square in two directions on each side. Meanwhile, the road lead from the square to the end of the 99th street in two directions (from the square to the intersection of 99th street and the intersection of the bridge to the square). The last road lead to the square from 56th street square to the end of 56th street (Municipality of Karrada). Figure 2 shows a satellite image of the study area. According to Traffic Department statistics / Al-Rusafa branch, the number of vehicles serving this arena is estimated more than 12 million vehicles annually (Traffic Department / Rusafa). Therefore, the area study suffers from severe traffic jams during peak hours led to delay the users. Meanwhile, the use of private transport become a reliable source of transport because of the lack of public transport.

The methodology was adopted in several stages, to study the advantages of intelligent transportation system in the field of environmental protection and harmful gases reducing. Field surveys were conducted to measure the traffic volumes of the study area, in addition to collect the information through visits to Karrada municipality

1- Length and width of the streets lead to the study area (see Table 2)  
2- Traffic volumes in the morning and evening peak hours.  
3- Number of large and small vehicles.  
4- Speed.  
5- Building heights and tree afforestation rate.
Traffic surveys were conducted on the traffic volumes of all the roads served by the square in the morning and evening peak hours. Traffic counting of road classification is according to traffic volumes and type of vehicle (see Table 3). The fieldwork was carried out in different traffic flow characteristics (types of traffic and density and speed of vehicles). Additional data required for regression equations, such as road width, height of buildings on roads and afforestation rate (according to model specifications, dense trees 1, zero trees 0, as shown in Tables (4-6) and Figures (3-6).

Figure 2. Satellite image of the study area.

Table 2. Names and lengths of the streets of the study area

| Seq | Street name   | Street length/m | Street length/m |
|-----|---------------|-----------------|-----------------|
| 1   | 99th Street   | 24832           | 20              |
| 2   | 54th Street   | 3000            | 20              |
| 2-- | 56th Street   | 3336            | 60              |

Municipality of Karrada - Department/ GIS.
Table 3. Main street classification surveys by traffic volume and type of vehicle in the morning and evening peak hours in the study area

| Seq. | Direction          | Time              | Small vehicle (vph) | Kia (vph) | Bicycles (vph) | Truck (vph) |
|------|-------------------|-------------------|---------------------|-----------|----------------|-------------|
| 1-   | St(54) Direction 1| 7-8 morning rush  | 720                 | 312       | 24             | ---         |
|      |                   | 1-2 Evening rush  | 936                 | 192       | 12             | 36          |
| 2-   | St(54) Direction 2| 7-8 morning rush  | 876                 | 216       | 12             | 36          |
|      |                   | 1-2 Evening rush  | 888                 | 156       | 12             | 12          |
| 3-   | St(99) Direction 1| 7-8 morning rush  | 900                 | 492       | ---            | 48          |
|      |                   | 1-2 Evening rush  | 1128                | 372       | 60             | 60          |
| 4-   | St(99) Direction 2| 7-8 morning rush  | 1116                | 450       | 48             | 60          |
|      |                   | 1-2 Evening rush  | 972                 | 540       | 60             | ---         |
| 5-   | St(99) Direction 3| 7-8 morning rush  | 1536                | ---       | ---            | 204         |
|      |                   | 1-2 Evening rush  | 1416                | 396       | 60             | 36          |
| 6-   | St(99) Direction 4| 7-8 morning rush  | 840                 | 660       | ---            | 84          |
|      |                   | 1-2 Evening rush  | 1440                | 480       | 60             | 36          |
| 7-   | St(56) Direction 1| 7-8 morning rush  | 324                 | 72        | 36             | 36          |
|      |                   | 1-2 Evening rush  | 720                 | 144       | 36             | 24          |
| 8-   | St(56) Direction 2| 7-8 morning rush  | 960                 | 72        | 48             | 12          |
|      |                   | 1-2 Evening rush  | ---                 | ---       | ---            | ---         |

Table 4. Represents the volumes of traffic (PCU) and speed during the morning rush hour, and some of the roads characteristics

| Direction          | Time   | Traffic volumes (V/h) | Speed (Km/h) | buildings Height (m) | Forestation |
|--------------------|--------|-----------------------|--------------|----------------------|-------------|
| St(54) Direction 1 | 8.5-9.5| 1356                  | 50           | 12                   | 1           |
| St(54) Direction 2 | 8.5-7.5| 1422                  | 60           | 12                   | 1           |
| St(99) Direction 1 | 8.5-7.5| 2028                  | 60           | 12                   | 1           |
| St(99) Direction 2 | 8.5-7.5| 2380                  | 70           | 12                   | 1           |
| St(99) Direction 3 | 8.5-7.5| 2148                  | 70           | 12                   | 1           |
| St(99) Direction 4 | 8.5-7.5| 2392                  | 60           | 12                   | 1           |
| St(56) Direction 1 | 8.5-7.5| 594                   | 40           | 12                   | 1           |
| St(56) Direction 2 | 8.5-7.5| 1164                  | 40           | 12                   | 1           |

Table 5. Shows PCU ratios for each type of vehicle

| Type of the vehicle | PCU  |
|---------------------|------|
| bicycle             | 0.33 |
| Motorcycle           | 0.75 |
| Small vehicle       | 1    |
| small bus           | 1.5  |
| Small truck         | 1.75 |
| big truck            | 2.5  |
| Large bus            | 3    |
Table 6. Represents the volumes of traffic (PCU) and speed during the evening rush hour, and some of the roads characteristics

| Direction     | Time  | Traffic volumes (V/h) | Speed (Km/h) | buildings Height (m) | Forestation |
|---------------|-------|------------------------|--------------|----------------------|-------------|
| St(54)Direction 1 | 1.5-2.5 | 1434                   | 50           | 12                   | 1           |
| St(54) Direction 2 | 1.5-2.5 | 1242                   | 60           | 12                   | 1           |
| St(99) Direction 1 | 1.5-2.5 | 2028                   | 60           | 12                   | 1           |
| St(99) Direction 2 | 1.5-2.5 | 2028                   | 70           | 12                   | 1           |
| St(99) Direction 3 | 1.5-2.5 | 1346                   | 70           | 12                   | 1           |
| St(99) Direction 4 | 1.5-2.5 | 2538                   | 60           | 12                   | 1           |
| St(56) Direction 1 | 1.5-2.5 | 1098                   | 40           | 12                   | 1           |
| St(56) Direction 2 | 1.5-2.5 | 1260                   | 40           | 12                   | 1           |

The percentage of emissions of polluting gases resulting from traffic was based on the regression equations in the study area before applying the intelligent transport system, as shown in Tables (7&8).

Table 7. Emissions rate derived from the regression equations/AM.

| Seq. | Emission type     | Street 99 | Street 54 | Street 56 |
|------|-------------------|-----------|-----------|-----------|
| 1    | Carbon monoxide (CO) | 45.7°     | 46.2°     | 32.0°     |
|      |                    | 54.9°     | 44.3°     | 34.3°     |
| 2    | Nitrogen dioxide (NO2) | 267.2°    | 71.6°     | 39.5°     |
|      |                    | 268°      | 76.5°     | 59.1°     |
| 3    | Lead (Pb)         | 1.8°      | 1.5°      | 0.6°      |
|      |                    | 1.8°      | 1.1°      | 0.9°      |
| 4    | Particulate(2Hhr) | 167.0°    | 99.4°     | 49.1°     |
|      |                    | 167.0°    | 103.7°    | 86.7°     |

° Exceed standard limits

Figure 3. Emissions derived from by the regression. Equations /AM/ Direction (1)
Figure 4. Emissions derived from by the regression. Equations /AM /Direction (2)

Table 8. Emissions rate derived from the regression equations/PM

| Seq. | Emission type       | Street 99 | Street 54 | Street 56 |
|------|---------------------|-----------|-----------|-----------|
| 1-   | Carbon monoxide (CO) | 49.2\(^a\) | 50.7\(^a\) | 33.4      |
|      |                     | 55.2\(^a\) | 43.9\(^a\) | 29.1      |
| 2-   | Nitrogen dioxide (NO\(_2\)) | 157\(^a\) | 77.5      | 59.99     |
|      |                     | 223.2\(^a\) | 63.8      | 70.08     |
| 3-   | Lead (Pb)           | 1.5\(^a\)  | 1.1       | 0.8       |
|      |                     | 1.9\(^a\)  | 0.9       | 1.3       |
| 4-   | Particulate(2Hhr)   | 174.3\(^a\) | 104.5     | 82.4      |
|      |                     | 177.4\(^a\) | 91.9      | 93.1      |

\(^a\) Exceed standard limits

Figure 5. Emissions derived from by the regression. Equations /PM /Direction (1)
In order to simulate the ITS application, the interest rate of this application was measured based on the study of the application of intelligent transport system in multiple countries to reduce traffic volume in the future. Based on the opinions of experts of traffic engineering and transport planning was reduced 35%. The equation (1) was used to calculate the volumes of traffic. Tables (9) and (10) show the speed and volumes of traffic. Regression equations were applied to the data with the remaining variables constant as presented in Tables (11 & 12) and Figures (7-10).

Table 9. Represents the volumes of traffic (PCU) and speed during the morning rush hour, and some of the roads characteristics after applied the indicator of traffic volume (0.35) with ITS.

| Direction | Time  | Traffic volumes (V/h) | Speed (Km/h) | buildings | Forestation |
|-----------|-------|------------------------|--------------|-----------|-------------|
| St(54) Direction 1 | 7.5-8.5 | 881 | 50 | 12 | 1 |
| St(54) Direction 2 | 7.5-8.5 | 924 | 60 | 12 | 1 |
| St(99) Direction 1 | 7.5-8.5 | 1318 | 60 | 12 | 1 |
| St(99) Direction 2 | 7.5-8.5 | 1547 | 70 | 12 | 1 |
| St(99) Direction 3 | 7.5-8.5 | 1396 | 70 | 12 | 1 |
| St(99) Direction 4 | 7.5-8.5 | 1554 | 60 | 12 | 1 |
| St(56) Direction 1 | 7.5-8.5 | 386 | 40 | 12 | 1 |
| St(56) Direction 2 | 7.5-8.5 | 756 | 40 | 12 | 1 |
Table 10. Represents the volumes of traffic (PCU) and speed during the evening Rush hour, and some of the roads characteristics after applied the indicator of Traffic volume (0.35) with ITS.

| Direction      | Time   | Traffic volumes (V/h) | Speed (Km/h) | buildings Height (m) | Forestation |
|----------------|--------|------------------------|--------------|----------------------|-------------|
| St(54) Direction 1 | 1.5-2.5 | 932                    | 50           | 12                   | 1           |
| St(54) Direction 2 | 1.5-2.5 | 807                    | 60           | 12                   | 1           |
| St(99) Direction 1 | 1.5-2.5 | 1353                   | 60           | 12                   | 1           |
| St(99) Direction 2 | 1.5-2.5 | 1353                   | 70           | 12                   | 1           |
| St(99) Direction 3 | 1.5-2.5 | 874                    | 70           | 12                   | 1           |
| St(99) Direction 4 | 1.5-2.5 | 1649                   | 60           | 12                   | 1           |
| St(56) Direction 1 | 1.5-2.5 | 713                    | 40           | 12                   | 1           |
| St(56) Direction 2 | 1.5-2.5 | 819                    | 40           | 12                   | 1           |

Table 11. Emissions rate derived by the regression equations with ITS/AM

| Seq. | Emission type          | Street 99 | Street 54 | Street 56 |
|------|------------------------|-----------|-----------|-----------|
| 1-   | Carbon monoxide (CO)   | 40.1<sup>a</sup> | 39.1<sup>a</sup> | 22.1<sup>b</sup> |
|      |                        | 42.0<sup>a</sup> | 33.1<sup>b</sup> | 27.8<sup>b</sup> |
| 2-   | Nitrogen dioxide (NO2) | 87.4<sup>b</sup> | 46.2<sup>b</sup> | 38.9<sup>b</sup> |
|      |                        | 86.9<sup>b</sup> | 47.7<sup>b</sup> | 42.5<sup>b</sup> |
| 3-   | Lead (Pb)              | 1.1<sup>b</sup> | 0.7<sup>b</sup> | 0.6<sup>b</sup> |
|      |                        | 1.2<sup>b</sup> | 0.7<sup>b</sup> |          |
|      | Particulate(2Hhr)      | 112.0<sup>b</sup> | 68.0<sup>b</sup> | 45.5<sup>b</sup> |
|      |                        | 112.5<sup>b</sup> | 70.9<sup>b</sup> | 59.8<sup>b</sup> |

<sup>a</sup> Exceed standard limits
<sup>b</sup> within standard limits

Figure 7. Emissions rate derived by the regression equations with ITS/AM/Direction (1)
Figure 8. Emissions rate derived by the regression equations with ITS /AM/Direction (2)

Table 12. Emissions rate derived by the regression equations with ITS / PM

| Seq. | Emission type         | Street 99 | Street 54 | Street 56 |
|------|-----------------------|-----------|-----------|-----------|
| 1    | Carbon monoxide (CO)  | 40.7<sup>a</sup> | 40.9<sup>a</sup> | 27.1<sup>b</sup> |
|      |                       | 51.7<sup>a</sup> | 38.3<sup>a</sup> | 29.3<sup>b</sup> |
| 2    | Nitrogen dioxide (NO<sub>2</sub>) | 71.4<sup>b</sup> | 57.0<sup>b</sup> | 41.5<sup>b</sup> |
|      |                       | 96.2<sup>b</sup> | 43.8<sup>b</sup> | 44.2<sup>b</sup> |
| 3    | Lead (Pb)             | 0.7<sup>b</sup>  | 0.7<sup>b</sup>  | 0.5<sup>b</sup>  |
|      |                       | 1.0<sup>b</sup>  | 0.6<sup>b</sup>  | 0.6<sup>b</sup>  |
| 4    | Particulate(2Hhr)     | 99.2<sup>b</sup> | 71.4<sup>b</sup> | 56.9<sup>b</sup> |
|      |                       | 118.7<sup>b</sup> | 63.2<sup>b</sup> | 63.9<sup>b</sup> |

<sup>a</sup> Exceed standard limits
<sup>b</sup> within standard limits

Figure 9. Emissions rate derived by the regression equations with ITS /PM/Direction (1)
4. Practical Research

Regression equations have been used to determine the rate of vehicle emissions on the roads connected to the study area. Some of these equations depend only on the volume of traffic, while others require additional variables such as road capacity, traffic type, traffic flow, height of buildings and afforestation. The results are presented in Tables (3-5) which represent the results for the morning and evening surveys of the study area.

According to the results study, the pollutant levels are high compared to international standards. The emission rates were highest as compared to the acceptable rates of emissions by WHO and some other developed countries, shown in Tables (6&7). The concentration of carbon monoxide CO was 50 ppm higher than the global average. While the NO₂ concentration on one of the main streets was more than 200 mg / m³. Also, high levels of contaminants and suspended particles were also found.

Table (10) presents the benefit of the application of intelligent transport systems by reduce the levels of traffic volumes at peak hours by 35%, using regression equations. Tables (11&12) show the results of future levels of pollution. After comparing with international standards, it was concluded that the application of intelligent transport systems have been contributed to reduce the proportions of polluting gases. Even if the reduction of levels of polluting gases does not reach the standard levels. Thus, these systems do not treatment the pollution problems resulting from traffic and congestion permanently, but contribute effectively to reduce pollution rates by almost half according to international emission standards.

The using of intelligent transport services plays a vital role in achieving sustainable development requirements by reducing the negative environmental impact of transport. This research indicate the contribution of ICT through application public transport usage, reducing overall traffic volume and unnecessary trips, as well as the duration of the additional search for parking is reduced. By using ITS application, the negative effects of transport such as greenhouse gas emissions and air pollution will decrease. The data results showed that the applications could reduce gases emissions by almost half. However, there are many factors to consider when determining air quality rates, including driver behavior with these systems and number of users in this city.

The results of the study showed the relationship between the effects of intelligent transport systems and environmental pollution through environmental changes and types of transportation usage. These systems contribute to reduce the negative behavior of the transport institutions towards the environment and to meet the requirements of sustainable development. The results indicate that the study area suffers of the traffic congestion, especially in the morning and evening peak hours.
Meanwhile, traffic volumes of street surveys connected to the yard of the study area found the high level of traffic volumes. The intelligent transport system from previous studies were applied to reduce the congestion ratio. The VMS implementation and the CCTV system were used. The reduction index of the traffic volume was 35% in the study hours.

The air pollution percentage has been measured in the traffic jams by using the application of intelligent transport system and using the same regression equations to determine the percentage of environmental pollution of the gases (carbon monoxide, nitrogen oxides, lead, suspended minutes) depended on the traffic volumes and the height of buildings. The results show that the low proportion of polluting gases reached typical proportions as compared with the standards. The some types of gases despite the low level of environmental pollution, but still do not reach the limits of the model

Generally, the use of smart transport systems helps to reduce the percentage of polluting gases. It is one of the many solutions to reduce traffic congestion and preserve the environment and sustainability. All results are illustrated using tables and charts shown in the search.

5. Conclusions
The conclusion, this research was necessary to find appropriate proposals for reducing the environmental pollution caused by cars due to traffic jams.
1- The study area is needed to regulate the traffic using traffic signals. It helps to regulate the speed of traffic by the modern traffic systems. The management of traffic regulation based on intelligent systems of transport for all roads led to the improvement of the traffic and reduce the congestion. Reducing the emissions resulting from the stop and the refined conduct of vehicles, thus reducing environmental pollution.
2- The smart transport systems used to increase the efficiency and organization of the arena. By making corridors of the movement does not contradict with the movement of vehicles.
3- Provide a proposal for the construction of a bridge or tunnel, which is one of the reasons for reducing congestion.
4- The arena transform to the intersection and the deployment of traffic signals to control the movement.
5- Activate the role of the state in the import of vehicles through the issuance of appropriate laws. The road tasks will provide that vehicles are suitable for use with intelligent systems of transport in case of application.
6- To make the environment balancing in the vicinity of the study area is by increasing the cultivated green areas. As it reduces pollutants and polluting gases.
7- Determination of the building height in the study area is important because it has an impact on environmental pollution.

The study has dealt with one of the important squares in the municipality of Karrada to benefit by the application of smart systems and reduce environmental pollution. This study could be an application model on all intersections and squares in the city of Baghdad to reduce the congestion and problems resulting from it and preserve the environment.

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