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Intelligent transportation system as tool in solving Cairo's transportation problems

Ahmed Hosney Radwan
Assistant professor of Architecture - Architecture Department
Faculty of Fine Arts, Helwan University,
Cairo, Egypt.
ahosney@gmail.com

Abstract — Traffic congestion in Cairo has many causes: fuel subsidies result in cheap petrol and diesel, which in turn result in more private cars on the streets, meanwhile the lack of parking areas results in cars having to turn back or park incorrectly on the streets prompting further traffic jams. Although the number of metro commuters is high, the metro only reaches a limited number of places in the city. Also, public transport buses are few in number and outdated, thus prompting people to use other buses and taxis to get by. However the latter generally need to be cleaner, safer and be able to better load and unload passengers. There are also few areas for pedestrians to cross the streets and street peddlers often occupy these areas and the sidewalks, making things worse. Moreover, there are many problems related to the construction of roads where there are few street lights, stop signs and crossroads; people also find awful corners and U-turns that are either very sharp turns or are very narrow thus not allowing drivers to make smooth U-turns. Drivers also behave badly and irresponsibly added to the poor implementation of traffic laws, which causes the public to undermine traffic regulations. In this paper we will discuss intelligent transportation systems (ITS) which is a nontraditional tool for solving traffic problems in Cairo and holds great promise for public works professionals seeking to optimize those public investment strategies that deal with traffic congestion and other growth pressures. Advanced traffic and fleet management systems as well as traveler information and vehicle-based systems can take advantage of information technology advances and private market products to substantially improve the productivity, connectivity, and safety of transportation, and its application in Cairo to improve traffic.

Index Terms — Intelligent Grid, Intelligent Roads, Intelligent Transportation, Intelligent Transportation Applications, Intelligent Transportation Technologies, Traffic jam

I. *Introduction*

Information technology (IT) has transformed many industries, from education to health care to government, and is now in the early stages of transforming transportation systems. While many think improving a country's transportation system solely means building new roads or repairing aging infrastructures, the future of transportation lies not only in concrete and steel, but also increasingly in using IT. IT enables elements within the transportation system vehicles, roads, traffic lights, message signs, etc. to become intelligent by embedding them with microchips and sensors and empowering them to communicate with each other through wireless technologies. In the leading nations in the world, Intelligent Transportation Systems (ITS) "which is an emerging transportation system comprised of an advanced information and telecommunications network for users, roads and vehicles and an integrated application of advanced Technologies using electronics, computers, communications, and advanced sensors." bring significant improvement in transportation system performance, including reduced congestion, increased safety, and reduction of energy consumption by vehicles, reduction of emission of CO_2 and traveler convenience. [1] Traffic Congestion is a major problem in most cities. It's a non-productive, time-wasting activity for most people especially private transportation. It causes the inability to forecast travel time accurately, leading to drivers allocating more time to travel, and less time on productive activities. The stress possessing the motorists encourages road rage and reduces their ability to be productive thus decreasing their health. The size of the problem varies from one area in a city to another but at the end of the day is a major problem for all mega cities. Cairo is directly affected by this problem. Various attempts to solve the problem have been made but none have been proven to be affective. Surprisingly some of the solutions caused even more traffic congestion. In order to find the proper solutions for the traffic congestion in Cairo various factors must be studied carefully to lead the proper choice of decision based on previous experiences of other cities with similar conditions. This research aims to study the traffic congestion and the possible sustainable solutions which will be directed towards the usage of intelligent transportation systems. [2]

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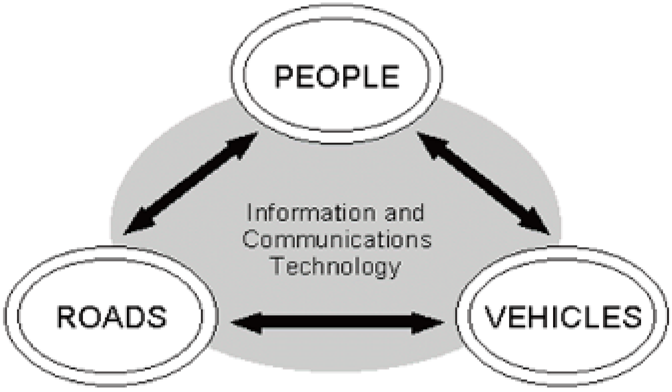

Figure 1: There should be a relationship between people, roads and vehicles to achieve ITS

II. MAIN OBJECTIVE

To achieve a transportation system that is:

- Resource efficient
- Climate environment friendly
- Safe
- Seamless friendly for the benefit of citizens, economy and society
- To boost competitiveness of Egyptian transport[3]

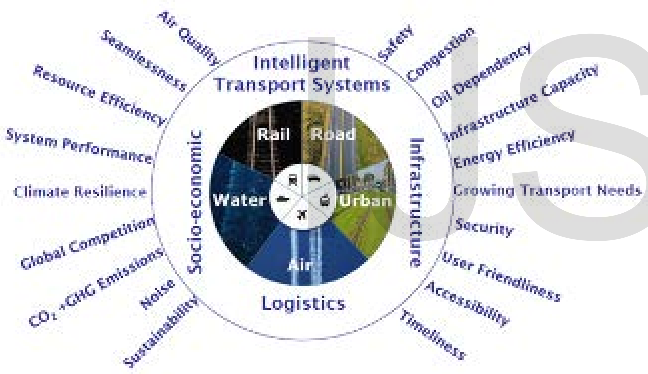

Figure 2: Intelligent Transportation - https://ec.europa.eu/programmes/horizon2020

III. SECONDARY OJECTIVE

Why ITS ?

- Interest in ITS comes from the problems caused by traffic congestion and a synergy of new information technology for simulation, real-time control, and communications net-works.

- Traffic congestion has been increasing worldwide as a result of increased motorization, urbanization, population growth, and changes in population density.

-Congestion reduces efficiency of transportation infrastructure and increases travel time, air pollution, and fuel consumption. - Many of the proposed ITS systems also involve surveil-lance of the roadways.

- Further, ITS can play a role in the rapid mass evacuation of people in urban centers after large casualty events such as a result of a natural disaster or threat. [4]

IV. WHO WILL MAKE USE OF ITS CONCLUSIONS

-Every vehicle owner or driver will make use of intelligent Transportation system, since it will reduce the usage of CO2 which will make it environmentally friendly, reduce collisions, and reduce energy consumption from transport.

-Hospital and Emergency vehicles will use intelligent transportation to fast and easily at the accident place using technology and GPS.

V. THE USED METHODOLOGY

There are 3 Methodologies used in this research:
First: Observatory
Defining the ITS, its technologies, its applications.
Second: Analytical
How to resolve the transportation problem using ITS
Third: Case Studies
Case studies of countries using ITS

VI. RESEARCH SKELETON

A. Introduction [5]

What is the Transportation Problem?

- Vehicle-Oriented Mobility
- Managing Road Traffic and Congestion
- Efficiency-driven Mass-Mobility
- Dedicated (Non-shared) Mobility
- Fixed Point, Static Data Collection and Charging
- No safety on roads
- Increase CO2

B. How could we resolve transportation problem?

1st Strategy
– Implement innovative and sustainable smart mobility solutions
2nd Strategy
– Develop and adopt ITS standards
3rd Strategy
– Establish close partnerships and co-creation [6]

Figure 3: Intelligent transportation systems - http://www.lta.gov.sg/content/ltaweb/en/roads-and-motoring/managing-traffic-and-congestion/intelligent-transport-systems/SmartMobility2030.html

C. *What are Intelligent Transportation Systems?*

- ITS is the integrated application of advanced Technologies using electronics, computers, communications, and advanced sensors. These applications provide travelers with important information while improving the safety and efficiency of the transportation system.

-ITS is an emerging transportation system which is comprised of an advanced information and telecommunications network for users, roads and vehicles.

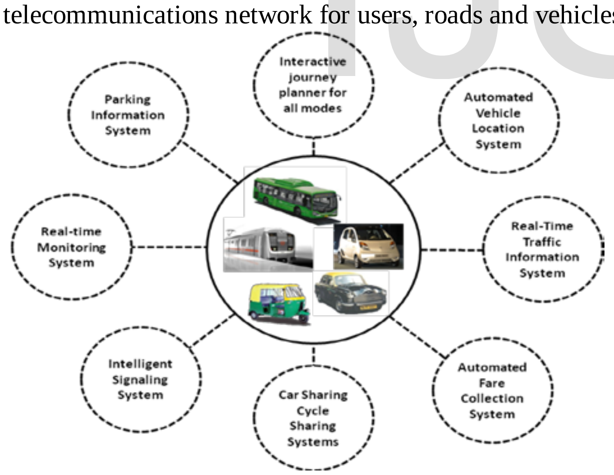

Figure 4: ITS - http://www.usroads.com/journals/rmej/9811/rm981101.htm

D. *Intelligent Transportation Technologies [7]*

1- Wireless Communications
Offers communication between the vehicle and the roadside Short Range (Electronic Fee Collection) Long and Medium range (including cellular & infrared links)

2- Computational Technologies
These technologies will be developed in sensors, travelers' computers, in-vehicle computers, and computers in the static infrastructure.

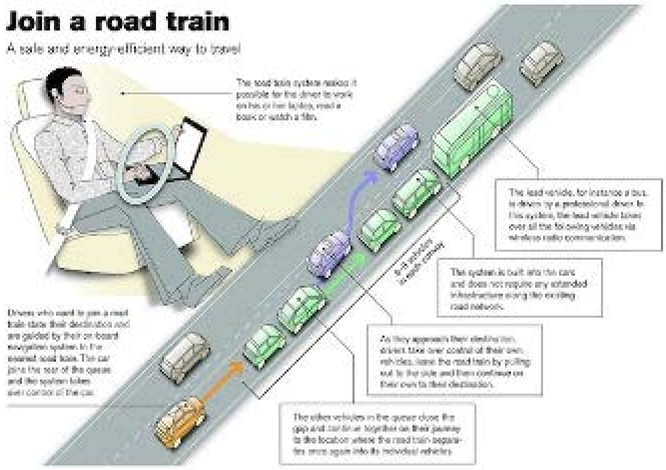

Figure 5: Computation Techologies - http://www.thecollegedriver.com/posts/1194-Volvo-Tests-Road-Train-Technology

3- Floating (Car - Cellular) Data Detection Techniques (Manual surveys- Video recording - Automatic Number Plate Recognition - GPS trace- Radio Signal Triangulation)

4- Sensing Technologies
Pavement loops used to sense the presence of vehicle demand at intersections and parking lot entrances. Pressure pads used to sense the presence of pedestrians waiting to cross a roadway. Radar used for detecting vehicles in the roadway.

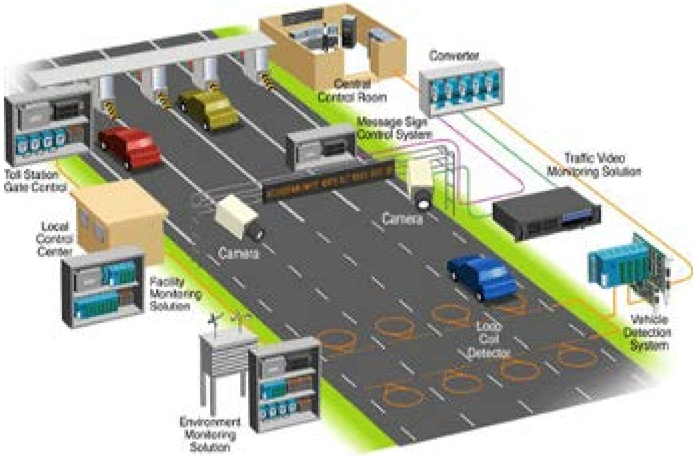

Figure 6: ITS technologies - http://www.tech-faq.com/intelligent-transportation-systems.html

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5- Inductive loop detection One or more loops of wire are embedded under the road & connected to a control box, when a vehicle passes over or rests on the loop, inductance is reduced showing a vehicle is present.

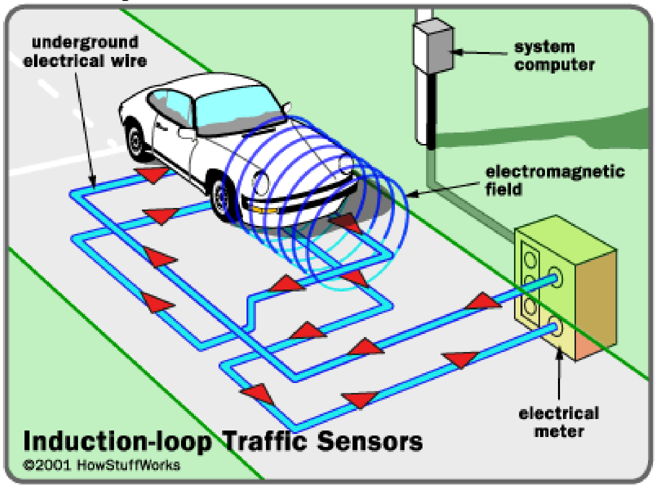

Figure 7: Inductive loop detection - http://www.slideshare.net/guest6d72ec/intelligent-transportation-system

6- Video Vehicle Detection Video detection is an image processor, it consists of a micro-processor-based CPU and software that analyzes video images.

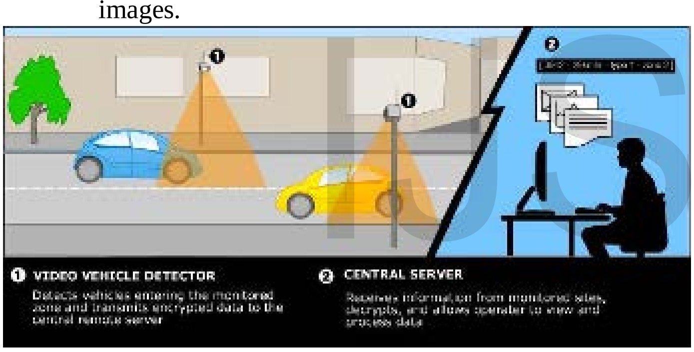

Figure 8: Video Vehicle Detection Video detection - http://vidimon.com/products_vd.htm

E. *Intelligent Transportation Applications*[8]

1- Electronic Toll Collection It detects and processes tolls electronically. Your account information is stored in the transponder. The antenna identifies your transponder and reads your account information. The amount of the toll is deducted and you're allowed through.

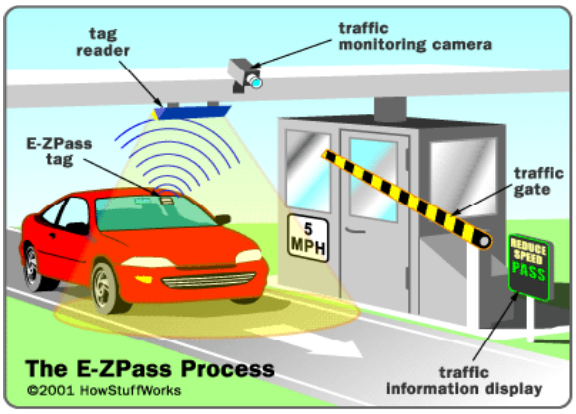

Figure 9: Electronic Toll Collection - http://ops.fhwa.dot.gov/freewaymgmt/publications/frwy_mgmt_handbook/chapter8_02.htm

2- Emergency vehicle
It can be used to provide advance warning to motorists of traffic jams, accidents and other emergency situations. This system can then provide alternative routes or recommendations to motorists so as to avoid congestion and travel delays

3- Cordon zones with congestion pricing
Cordon systems make it possible to collect taxes from those entering city areas with high traffic while encouraging the use of mass transit. It can be enforced where mass transportation systems are available and their use encouraged.

4- Automatic Road Enforcement
It is used to detect and identify vehicles disobeying a speed limit or some other road legal requirement and automatically ticket offenders based on the license plate number.

Speed limit - cross a stop line - vehicles traveling in bus's lanes

5- Emergency Management Services Enhanced by traffic control centers that continually monitor roadway conditions. When an incident occurs, the nearest emergency service vehicle is located electronically and dispatched to the scene. Highway managers then alert other drivers of the incident through dynamic message signs. These services reduce response times, help save lives, and reduce the occurrence of secondary incidents.

6- Traveler Information Service
- Information is generated by (Traffic Sensor- Aerial surveillance - Weather Monitoring - Incident Detection)
- Sent to Travelers by Emergency Alerts

- Travelers Respond (Change Route -Change Departure Time -Change Mode - Change Destination)

7- Collision Avoidance Systems

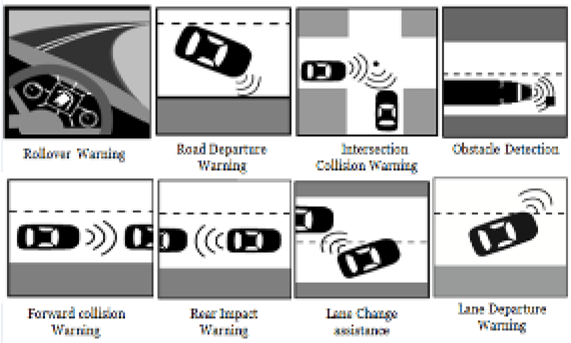

Figure 10: Collision avoiding systems - http://www.slideshare.net/guest6d72ec/intelligent-transportation-system

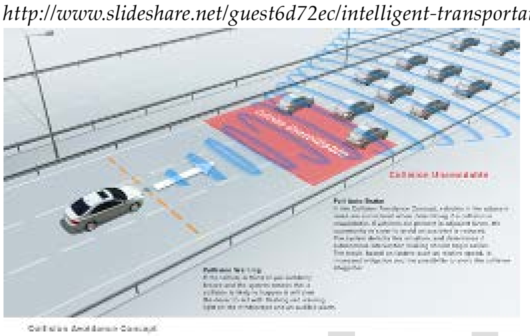

Figure 11: Collision Avoidance Concept - http://www.etsi.org/technologies-clusters/technologies/intelligent-transport

F. Intelligent Roads

- Is an innovative concept for smart roads of tomorrow
- A programmer of innovation that links a different way of looking at things with innovative ideas that apply the opportunities offered by new technologies in smart ways
- The themes sustainability, safety and perception are key to the concept and are manifested in the newest technologies in energy and light.

G. Intelligent Road Enforcement [9]

- Speed cameras: that identify vehicles traveling over the legal speed limit. Many such devices use radar to detect a vehicle's speed or electromagnetic loops buried in each lane of the road.
- Red light cameras: that detect vehicles that cross a stop line or designated stopping place while a red traffic light is showing.
- Bus lane cameras: that identify vehicles traveling in lanes reserved for buses. In some jurisdictions, bus lanes can also be used by taxis or vehicles engaged in carpooling.
- Level crossing cameras: that identify vehicles crossing rail-ways at grade illegally.
- Double white line cameras: that identify vehicles crossing these lines.
- High-occupancy vehicle lane cameras: for that identify vehicles violating HOV requirements.

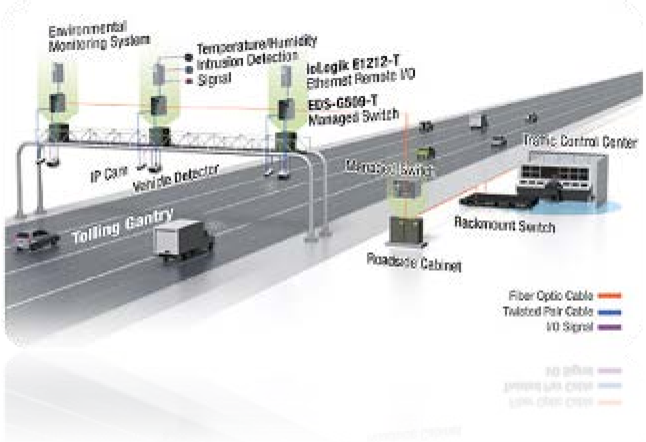

Figure 12: Intelligent road enforcement - http://www.moxa.com/application/French_Road_System.htm

H. Intelligent Transportation Systems can help to

- Reduce accidents
- Improve emergency response times - Increase community live ability by promoting increased use of public transit
- Drive sustainable economic development through the creation of new jobs, technologies and businesses - Solve Problems caused by Road
- Activate the Economy
- Coordinate different Transport Modes
- Reduce energy consumption from transport.
- Help the city be efficient productive, strong economically

I. Main Advantages of Intelligent Roads

1- Safety
- Find safe streets fit all users
- At all times of day, especially for pedestrians, and with a focus particularly on children, the elderly and people with Obstruction in the movement
- Give priority to users the most susceptible

2- The Context and Land use
- Street design process will respond closely with context Land use and the size of the generated traffic to accommodate the needs of Places and neighborhoods / residential neighborhoods
- Defines the types of activities on along the street, as it greatly affects the design fields Pedestrian

3- Effectiveness

- Provides an effective movement for all Types of transportation.
- A rise in the level of interdependence between the squares Residential

4- Sustainability

- Streets will encourage walking, mobility
- Bicycles, and the use of public transport to reduce emissions Carbon resulting from the use of vehicles
- Low time car stopped and the distance traveled by the Destination intended to reduce carbon emissions and protect the rates Natural resources
- Will provide shade in public places to reduce the high
- Temperatures, and then raise the comfort levels of pedestrian

5- Public Health

- Good design of the streets will lead to higher rates of walking and cycling throughout the year
- Good design of streets and improve public health level Will lead to a decline in rates of obesity, heart disease, diabetes and mental health issues

6- Economic Development and Tourism

- Attract urban streets vibrant and active investors, and retailers, hoteliers and residents
- Good design of the streets will support the rise in property values Based on the length and success of the shops.
- Will provide high-quality facilities for all types of transportation to attract investors and tourists, and then support the development Economic urban

7- Culture and public image

- Well-designed streets, as well as all public places provide luminous image using global standards, through internal and external attention to detail, starting from the quiet residential streets to spacious ceremonial streets.
- Design takes into account
  -Public spaces
  -Maintaining traditions
  -And local culture
- Maintenance of the infrastructure of the streets according to the highest standards International, consistent with the bright image of the city

J. Main Advantages of Intelligent Transportation

1- Safety [10]
Safe Bus system provides: Passenger compartment video surveillance Video recording of traffic situation and events in passenger and driver compartments Concealed alarm button ("Panic button") for alerting the dispatcher or emergency response services Monitoring passenger compartment conditions (air temperature, smoke detection) Monitoring passenger flows using proximity sensors mounted above bus doors, for counting passengers that board and exit the bus Display of the route number, departure and destination points, and travel direction Display of the name of the next stop on the scrolling text display board

2- Efficiency [11]
For example, proper signal timing and real-time traffic in-formation reduce volume-related congestion and prevent accidents that lead to more delays. Less congestion means lower emissions, less wasted fuel and higher productivity. In addition, making smarter use of existing capacity means fewer new roads need to be constructed, road-widening be-comes less necessary, and more resources are available to ensure physical integrity and safety of existing roads and bridges.

3- Mobility
The number of people traveling and the volume of goods transported is increasing worldwide. The need for mobility by road, rail and ocean is on the rise. Enable Advanced Traveler Information System (Enable ATIS) Freight Advanced Traveler Information Systems (FRATIS) Integrated Dynamic Transit Operation (IDTO) Intelligent Network Flow Optimization (INFLO) Multi-Modal Intelligent Traffic Signal Systems (MMITSS)

4- Environment [12]
Create a new energy system and shift from single directional to multidirectional energy system. Examples include the conversion of transportation and energy management systems such as EVs, V2Hs (Vehicle to Home), and V2Gs (Vehicle to Grid). Clean energy sources and create a social system where sustainability equals better economy. This can be translated into: New equation for sustainability = better for the people = better for the environment = better for the economy.

K. Systems using ITS [13]

1- Smart way in Japan
2- IntelliDrive in the United States
3- Stockholm's congestion pricing scheme

ITS are contributing to a fundamental reassessment of vehicle safety. Whereas most developments in trans-portation safety over the past 50 years were designed to protect passengers in the event of a crash, VII and V2V systems such as Japan's Smart way or the United States'

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IntelliDrive are being designed to help motorists avoid the accident altogether. For example, the U.S. IntelliDrive system could potentially address 82 percent of vehicle crash scenarios involving unimpaired drivers.

ITS maximize the capacity of infrastructure, reducing the need to build additional highway capacity. For example, applying real-time traffic data to traffic signal lights can improve traffic flow significantly, reducing stops by as much as 40 percent, reducing travel time by 25 percent, cutting gas consumption by 10 percent (1.1 million gallons of gas annually), and cutting emissions by 22 percent (cutting daily carbon dioxide emissions by 9, 600 tons).

ITS can contribute significantly to reducing congestion by 20 percent or more, which costs commuters about 4.2 billion hours and 2.8 billion gallons of fuel each year.

ITS also enable transportation agencies to collect the real-time data needed to measure and improve the performance of the transportation system, making ITS the centerpiece of efforts to reform surface transportation systems and hold providers accountable for results.

By improving the operational performance of the transportation network, ITS enhance driver mobility and convenience, deliver environmental benefits, and even boost productivity and economic growth.

For Japan, ITS have been crucial as the country strived to meet its goal to reduce, by 2010, CO_2 emissions by 31 million tons below 2001 levels, with 11 million tons of savings come from improved traffic flow and another 11 million tons of savings from more effective use of vehicles.

Stockholm's congestion pricing scheme yielded immediate results, reducing traffic by 20 percent in the first month alone as many commuters opted for public transportation.15 Statistics gathered since the full implementation of Stockholm's congestion pricing scheme in 2007 show that the initiative has reduced both traffic congestion and carbon emissions by 15 percent on a sustained basis. Stockholm's congestion pricing scheme has also generated $120 million in net revenue.

L. Examples using ITS and its impact [14]

1- Smart parking in Ellicott City, Md. Ellicott City located a few miles west of Baltimore, installed a smart parking system downtown with the goal of increasing the turnover of its on-street parking and reducing the cruising for parking spaces. The city used sensors to collect occupancy data on parking spaces, transmitted the data to a central location, analyzed the data to optimize parking rates, and disseminated information on parking availability to the public via smart phone applications.
- The results: a 9.5% increase in parking turnover contributing to a 12% increase in local business revenue. SFPark, which conducted a similar parking initiative, found that adjusting prices reduced CO_2 emissions and excess vehicle-miles traveled by 30% over a control area.

2- Smithsonian advanced fleet management. The Smithsonian Institution implemented a telemetric solution for its fleet of 1,500 vehicles in the United States and Panama that tracked the location, condition, utilization and performance of each vehicle. The goal was to improve utilization, improve vehicle maintenance and cut fuel costs.
- The results: A reduction in the number of light-duty vehicles from 600 to 490, a 52.1% reduction in petroleum consumption, and a 490.8% increase in alternate fuel utilization.

3- Adaptive Signal Control in Pittsburgh.
Pa. Researchers at Carnegie Mellon University designed an adaptive signal control system in a nine-signal network in the East Liberty neighborhood of Pittsburgh. The signals operated autonomously — no central control — but communicated with each other to optimize signal timing and traffic flow.
- The results: a 25% improvement in travel time, fuel savings of 64,600 gallons per year, and a 21% decrease in CO_2 emissions.

4- Traffic light synchronization in Los Angeles County, CA. In traffic light synchronization, signals are coordinated to move traffic along a transportation corridor from one light to the next with minimum disruption, saving travel time and increasing throughput. In phase One, Los Angeles County equipped traffic signals with vehicle-detection equipment, GPS-based clocks and the ability to communication with signals at 780 intersections along 220 miles of street.
- The results: 31.3 million hours of travel time per year, 38 million gallons of fuel saved and 337,000 fewer tons of CO_2 emitted. Phase Two will expand synchronization to 2,670 intersections on 610 miles of road.[[15]]

M. Cairo's transportation system problem[[16]]

Traffic can seem to define Cairoites' lives, not least because so much of them play out in cars, sitting stationary in traffic. The city is home to 20m people, 2m cars and 23, 6000 miles of road. Long waits and terrible traffic jams mean many socialize through open windows, trading insults, cigarettes and small talk. One of the film's stars points out that for young men, who tend to live with their parents until marriage, their cars are the only space they have to themselves: "It's the place where you kick it with your friends." [17]

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Figure 13: Vehicles in rush hour

Traffic laws are largely ignored, and drivers take their cues to stop and go through a language of honking. The endless honking and chatting seems quite fun, but there's another side to the traffic. It blocks ambulances, kills pedestrians and causes horrible pileups, especially on the city's ring-road. Originally built to ease congestion, this road is now used just as recklessly as the city's other routes, and at higher speeds.

Figure 14: Vehicles in rush hour

The following maps show Cairo's traffic system and level of congestion at different times and days, where green is fastest traffic and brown is slowest. [18]

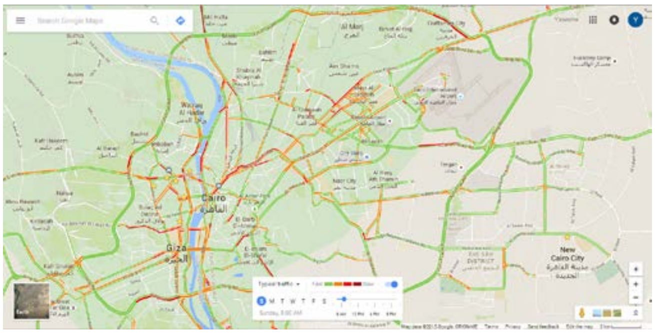

Figure 15: Cairo's roads map on Sunday at 8:00 am "Rush hour"

Figure 16: Cairo's roads map on Monday at 4:30 pm "Rush hour"

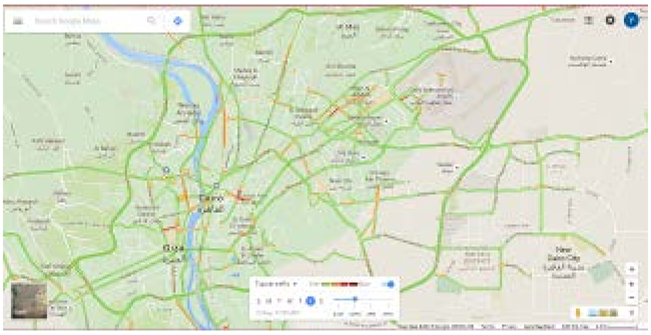

Figure 17: Cairo's roads map on Friday at 12:00 pm

A traffic density rating, Hourly traffic, traffic on weekdays and weekends were calculated from Bey2ollak website for an overall Cairo roads by Karim Ouda. [19]

Figure 18: Cairo Traffic Density - Hourly

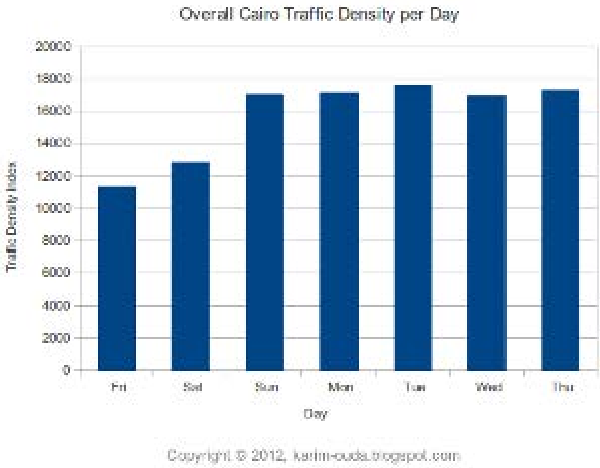

Figure 19: Overall Cairo Traffic Density - Daily

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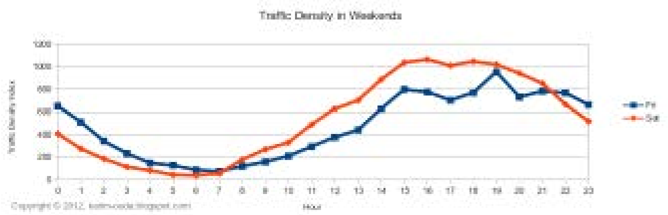

Figure 20: Overall Cairo Traffic Density - Weekends

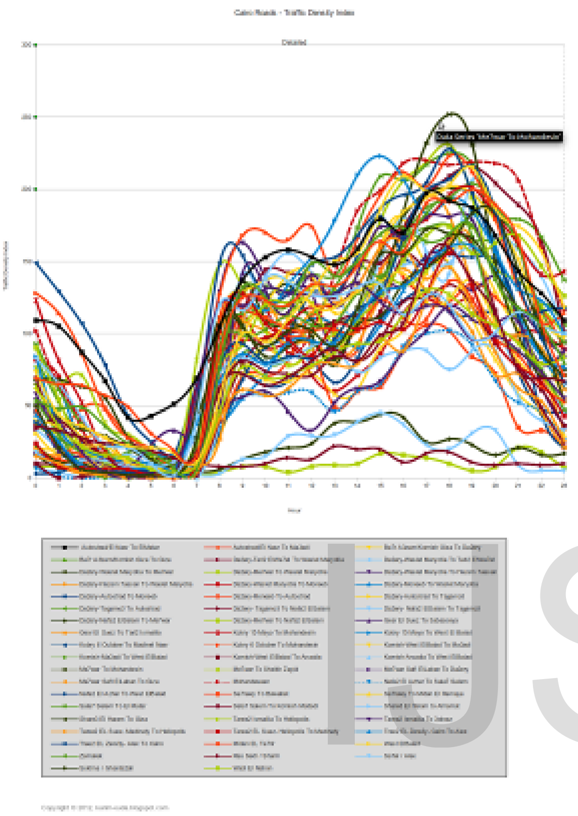

Figure 21: Overall Traffic Density - Detailed

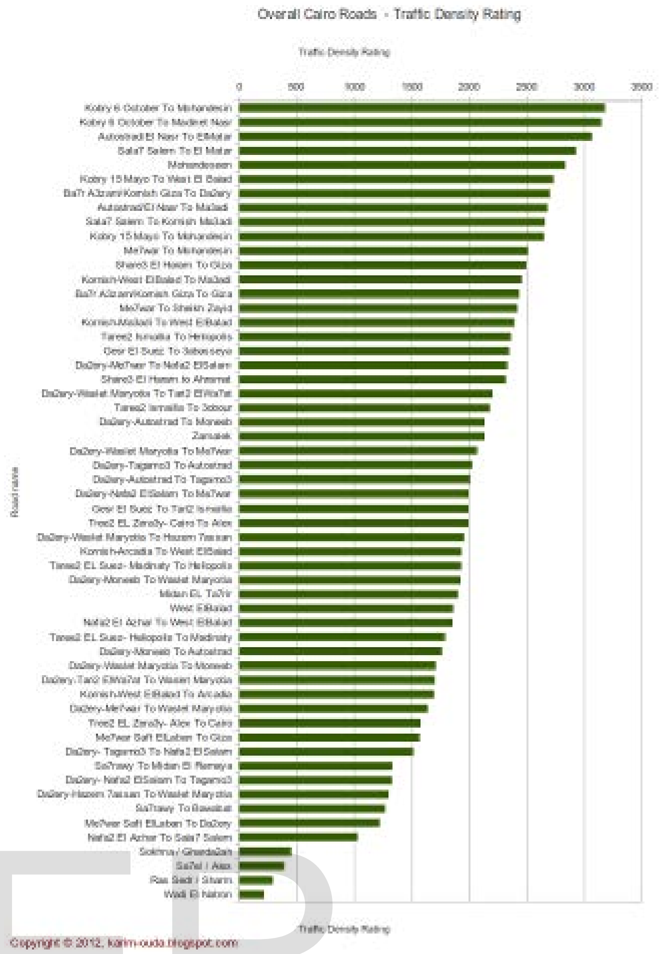

Figure 22: Overall Traffic Density Rating for Cairo Roads

The World Bank carried out a study on Cairo's traffic problems in 2010. It found that the annual cost of congestion in the greater metropolitan area amounted to around 50 billion Egyptian pounds a year: 4 per cent of Egypt's entire GDP. Even Jakarta, also densely populated, famous for its traffic and rapidly expanding, only loses 0.6 per cent of Indonesia's GDP to traffic costs.

It also found that the increase of Traffic Volumes causes:

– Non-uniform distribution of urban populations: Low income housing away from job opportunities and high income housing away from business opportunities

– Inadequate urban planning practices

– Poor observance of traffic laws

– Average daily commuting time more than 60 minutes, particularly to new cities

– Lack of proper infrastructure capacities to accommodate increased traffic demands. Large investments not keeping up with traffic congestion

– Limited parking supply

– Bad road design and inadequate traffic planning and control

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– Increased private car ownership: low bank loans, inexpensive fuel, coupled with increased local car production/assembly
– Lack of public transport coverage and low service levels and inter-modal transfer
– Lack of proper traffic management
– Yearly economic cost of traffic congestion could reach up to 4% of Egypt's GDP [20]

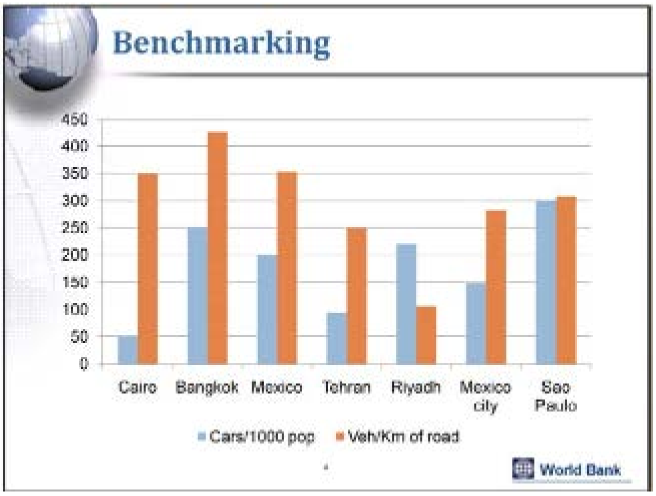

Figure 23: World Bank, 2011

The study recommended cutting back the fuel subsidies, which make up a fifth of the Egypt's government budget; it also wanted improvements to public transport and pedestrian routes, and a significant investment in traffic lights.

Fuel subsidies across Egypt were cut this year, increasing the price of gasoline by over 70 per cent and sparking protests. But some of the government's other attempts to tackle the problem don't quite match the World Bank's proposals. One recent road education campaign in schools involved students sitting at a red light in a toy car, explaining that they won't rush, even though they're late. They sing a traffic lights song, with lyrics that run:
"Yellow, yellow, yellow means wait, wait, wait...even if you're late, late late."
Each major event since 2009 has brought with it a change in the city's traffic patterns. During the revolution, when police were absent from the city's roads, citizens took to directing traffic themselves, and for a short period, drivers appeared to be following road laws.
The World Bank in 2014 created to scenarios to solve the traffic congestion in Cairo.
Scenario 1
In this scenario, government takes the necessary measures to reduce traffic congestion in Greater Cairo.

1. The current fuel subsidy reform decreases the use of vehicles, and hence the consumption of fuel, is rationalized.
2. A public program offering credit to car owners to repair their cars to become environmentally compliant or buy new affordable ones such as the Nano car of India.
3. Barriers to doing business in mass transportation are removed and the private sector invests in expanding the network to meet growing ridership and goods transportation demand; leading to a decrease in the number of small microbuses and tuk-tuks, realizing higher efficiency through economies of scale.
4. Private sector is engaged in building and managing parking areas and enforcement is intensified to reduce illegal parking and traffic jams.
5. Business and industrial activities become more productive by significantly reducing time and cost wasted in traffic.

In this scenario, Egypt would reduce traffic congestion costs from its current 4 percent of GDP to 0.6 percent of GDP by 2020 as in the case of Jakarta, Indonesia; saving LE 78 billion annually.

Scenario 2
In this scenario, policies regulating traffic remain unchanged and congestion worsens over time.

1. An average of LE 15 billion annually is spent on health issues related to traffic by 2020.
2. Business and industrial productivity losses reach around LE 8 billion annually by 2020 because of increasing traffic congestion.
3. Per capita opportunity cost of traffic congestion jumps to around LE 3,278 per year by 2020.
4. Ridership demand would grow exponentially beyond its current 37,000 per day per KM of public transport network which is currently 4 times that of Delhi, 1.7 times of Mexico and 1.23 times of Tokyo.

In this scenario, Egypt would incur a total annual cost of traffic congestion valued at LE 48 billion to reach LE 81 billion by 2020. [21]

ECES calculations based on "Cairo Traffic Congestion Study," World Bank, May 2014 and "Road Safety in Egypt," World Health Organization, 2012.

N. Main traffic congestion causing problem in Cairo [22]

1- Increase ownership of cars
2- Mismanagement of traffic
3- Traffic jams
4- No application of traffic laws
5- Unsuitable means of public transportation
Which have forced people to resort to using private
6- Centralization of services in Cairo which leads all the suburban residents to travel to Cairo to get their services done causing mass congestion in Cairo

O. Traditional Solutions to Cairo's transportation problem

Traffic expert Magdi El-Shahed told Ahram Online that several points actually contravene existing traffic laws.
One example, he said, is the stated plan to limit the movement of certain kinds of large vehicles in and around cities during certain times of the day. This, El-Shahed suggests, clashes with a law allowing heavy vehicles on the roads at any time if they pay a penalty fee.
Such contradictions are also apparent when it comes to several other points, he claims.
But perhaps the great problem, according to El-Shahed, is that the plan focuses on irrelevant points and ignores some of the greater issues.
One example is the declaration that all taxi drivers will be obliged to install meters.
"All cabs in Egypt have meters. The issue should be forcing driver to use them, not just have them," says El-Shahed. "But in any case, taxi meters have nothing to do with traffic congestion. They are irrelevant." [23]
Moreover, from the traditional solutions that were encountered was to encourage commuters to give up private cars and take public transport, Okail "adviser to the Ministry of Transport" said. But for this to happen, decent public transportation has to be made available either by the government or by the private sector.
Egypt's demand for transportation in the GCMA is 30 million trips a day, a trip being a one-way commute from one point to another. Some 22 million trips are currently covered, leaving a deficit of eight million "suppressed trips" that are either postponed or cancelled.
Previous attempts to ease congestion by opening new roads have not solved the capital's problems, Okail said. "At first the new roads provide some relief, but eventually they too become crowded because they encourage suppressed trips." As a result, new roads actually increase traffic problems. [24]

P. Solutions offered by ITS to Traditional Transportation problems we face everyday [25]

1- Technology for the interaction between road users, vehicles and road
Proper use of ITS will contribute to a safer transport system
Improve accessibility for all road users
Cause fewer environmental impacts from road transport.

2- Interurban Systems
- Traffic management on motorways is a necessity while traffic on our roads is increasing.
- The purpose of the motorway system is to improve road network efficiency, reliability and security.
- Motorway system provides for utilizing road capacity in the best possible way by using various control measures.
- The system can, for example, close one or more lanes on a stretch of road during road works or when an accidents happens and adapt the speed to the current conditions.
- The system provides for smoother traffic flow and improved traffic safety through lane signals, often combined with variable speed signs, and informs passengers about the imposed speed limit and lane restrictions.
- The goal is to maximize the throughput of the road network, avoiding bottlenecks and congestion and maintain traffic flow.

3- Traffic Information
Giving passengers the right information at the right time can improve mobility and safety. A good flow of information also provides a more comfortable journey causing up to 30% of motorists change the route when they receive travel information about obstacles on the road.
There is a nongovernmental intension called Bey2ollak which kind of informs travelers and road users about the traffic congestion on different roads in the city.
The government needs to apply an application like bey2ollak but an authenticated one by road administrators, not depending on people's tweets.

4- Creating E-government services with the objective of leveraging the full potential of information and communication technology (ICT) so as to improve the efficiency as well as the capability of government processes and services, with a specific focus on e-Services that will enable increased citizen participation and attempt to create an open, transparent environment, through the integration of different government information systems and services without having to travel distances to get their services accomplished.

5- Egypt has already started some nongovernmental intensions to solve traffic problems in an intelligent way such as Uber, Easy Taxi & Careem. These are mobile applications that are used to call taxis when needed using GPS, and on riding the taxi you confirm that the taxi has arrived, and when you arrive you pay for your ride either by money or visa card and rate the ride and the driver where these ratings help to monitor and improve the service levels. If this intension is generalized, eliminating the traditional taxis which are moving all around looking for passengers causing traffic congestion, and taxis would only be on call, it will cause less traffic.

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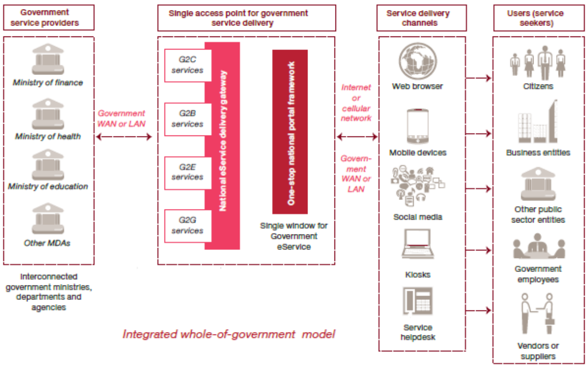

Figure 24: Integrated E-Government services model

Q. Conclusion

According to the analyses and discussions above, this paper's conclusions may be summarized as follows:
Cairo is a mega city with a major congestion problem. Therefore, it's caught up in an endless cycle of CO_2 emissions production and nonrenewable energy waste.
After studying the case in Cairo, the experiment proved that the increased ownership of private vehicles is one of the main causes of the congestion.
Traditional solutions such as constructing new roads networks, creating new traffic systems, using fines and penalty fees to force people to obey the law, limiting the movement of certain kinds of large vehicles in and around cities during certain times of the day … etc, has failed among the last decades to solve the transportation problem in Cairo due to the massive increase in number of cars.
The plan to decrease the problem is to AVOID the construction of new roads, which can only be done with the cooperation of the government and the reconsidering of its policies to solve the congestion problem.
SHIFT to the usage of intelligent transportation systems and intelligent roads.
IMPROVE the mode through technology and policy, which is also the role of the government [[26]]

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