INTEGRATION OF GPS AND GIS TO STUDY TRAFFIC CONGESTION ON CAIRO ROAD NETWORK TO MINIMIZE THE HARMFULL ENVIRONMENTAL EFFECTS CASE STUDY (AUTOSTRAD ROAD)

By

Ahmed Hamdy Abd El-Latif Hassanin El-Mansy
B. Sc. Engineering, (Electric), Military Technical College, 1999

A Thesis Submitted in Partial Fulfillment
of
The Requirement for the Master Degree
in
Environmental Science

Department of Environmental Engineering Science
Institute of Environmental Studies & Research
Ain Shams University

2013

APPROVAL SHEET

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ACKNOWLEDGEMENT

First of all my thanks to **ALLAH** the most beneficent and merciful for helping me to accomplish this research.

I would like to express my utmost appreciation and deepest gratitude to

Prof. Dr. Ali Zein Elabdeen Salem Heikal

Head of Public Works Department,
Faculty of Engineering-Ain Shams University.

Dr. Ahmed Sayed Abo Taleb

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Under whose supervision to finish this work, their help, guidance, unlimited support, cooperation and constructive criticism, which were kindly given, are beyond acknowledgment.

I would like also to express my sincere thanks from my heart to my dear parents for their love, devotion, and never ending support to my studies and career.

Many thanks to my wife and my kids for being a source of hope and encouragement.

ABSTRACT

The evaluation of road traffic conditions is crucial work, and thus, transportation professionals have developed numerous measures including traffic volume, speed, and density. However, recent research efforts have indicated that such traditional measures may not provide the required accuracy and quality of the data, necessitating the development of alternative approaches that complement or replace the current traffic conditions measures.

For many years, the demand for a better method of acquiring travel time data became bigger. With the advent of the GPS, and its integration with the GIS, a better method came out and provided researchers with a more convenient and accurate way of gathering travel time information.

This thesis presents a procedure to extract traffic data using Global Positioning System (GPS) receivers and Geographic Information System (GIS) technology with the advantage of less labor, simplicity of equipment, automatic geo-coding, high measurements accuracy and relatively inexpensive.

GPS device was used to collect probe vehicle data every one second along Autostrad Road in both directions as a case study through the morning AM and evening PM peak hours. The road was divided into five homogeneous sections. The congestion points were also recorded using the GPS device. Manual classified counts were conducted to obtain the traffic volumes along Autostrad Road.

A vehicles emission model was used to calculate the CO_2 and NOx emission patterns along the road and to estimate the total emissions in each section on the bases of classified traffic volumes obtained from the manual counting.

Data analysis was made for each of the five sections of Autostrad Road separately, where both traffic and emissions data were analyzed. The most severe traffic condition was found in the fifth section started at Elseka Elhaded Club and ends at Elahli Club. The lowest speed occurred on Sunday PM peak hours was 23.39 (km/hr) In Helwan City direction and the highest speed was 38.41 (km/hr) on Monday AM peak hours. In Nasr City direction, the lowest speed occurred on Tuesday PM peak hours was 35.29 (km/hr) and the highest speed was 41.65 (km/hr) on Tuesday AM peak hours.

In all of Autostrad Road sections a strong positive correlation was found between the travel time and the emissions quantity for gasoline and trucks/buses vehicles and no correlation for the diesel vehicles.

The calculated CO_2 emissions were converted to the equivalent amount of fuel in order to calculate the effect of traffic condition in term of the fuel consumption. Economic assessment was conducted to measure the efficiency of a traffic enhancement solution on the bases of a target speed and acceleration. It was found that by enhancing the traffic conditions on Section 5 to achieve 50 (km/hr) speed and 0.5 m/s^2 acceleration, an approximate total of two millions liters of gasoline and one million liters of diesel can be saved annually in both direction of the road on section 5 during the AM and PM peaks. The value of the saved amount of fuel can be used to make constructions to enhance the traffic conditions and achieve the required speed on Section 5.

It is recommended that this method be generalized over Greater Cairo road network to help the traffic engineers to both quantify the congestion cases and perform the economical assessment of the proposed solutions to enhance the traffic condition and mitigate congestion.

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