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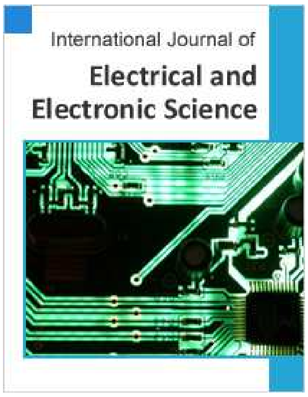

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Advanced Genetic Traffic Intelligent System

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Abstract

The application of Advanced Genetic Traffic Intelligent System (AGTIS)is considered, which can be uploaded on the internet and constructed in cooperation with Traffic Engineering Department in a city in a country. The presented system enables the travelers and traffic engineering department to be better informed, and make better traffic intelligent decisions. The system designed to make the movement of people and goods more efficient and economical. The overall architecture of the system, and the algorithm used to find the optimal path are designed. The AGTIS can be used as a guide for traffic navigation by the internet which is a very useful tool in the next generation of cars and a part of the traffic control systems of the Traffic Engineering Department. Therefore the presented system could be a base for a very powerful intelligent system which managing efficiently dynamic geographic and transportation data.

1. Introduction

Roads and traffic lie at the heart of modern civilization[1], the problem of controlling the road was and will still be a very important issue, and has been gaining interests to support more efficient control of transportation, since the road capacity is relatively scarce[2-8].Any traffic system must handle the following issues:

- Efficient control of roads and traffic [1].
- Saving human lives and time [9].
- Augmenting the overall safety of our roads [9].
- Reducing journey times and journey-related trip planning.
- Reducing some of the harmful transportation effects on the environment [10].

The proposed system can be considered as a navigation devices and traffic information services that inform drivers about the most efficient routes to use in order to avoid traffic delays and wrong directions.

AGTIS involves the Geographic Information System (GIS)[4] and analytical/decision models to produce systems able to cope with the problems of controlling roads. It aims to support decision making by applying quantitative approaches on the geographic information which is stored in a manipulability form within the GIS.

AGTIS manages optimal path which is composed of links and nodes [11],it supports efficient and fast handling of large data for traffic status incident information query, and finding optimal path.

AGTIS also handles road data such as traffic volume, road light, road width, road length, traffic light, road name, road setting, road –blocks, accidents, snow and flooding, and many other factors[9].

The system presented is designed for the city of Amman in Jordan where its Traffic Engineering Department strived to build safe and effective transportation systems, and employ it in good operating and controlling manner. The system can be implemented to any other city with some modifications.

2. System Methodology

The major targets of AGTIS are the construction of traffic information service center, integral traffic information guide, finding genetic optimal path, travel time guide, car navigation support, and all the desired goals such as reducing traveling time, minimizing the environment pollution, guiding travelers through unknown cities and areas, increasing safety on the roads.

The presented system performs the major input/output, presentation, search, and other functions related to the traffic and transport data.

3. Overall System

The overall architecture of the Advanced Genetic Traffic Intelligent System (AGTIS)is shown in Figure 1,AGTIS system is consist of four sections, which are[1-3]:

- Integrated genetic optimal path processing section to manage optimal path algorithm.
- General traffic information section to perform static data related to nodes, roads, and distances.
- Service information section to integrate service information guide.
- Specific traffic information section to integrate traffic information guide.

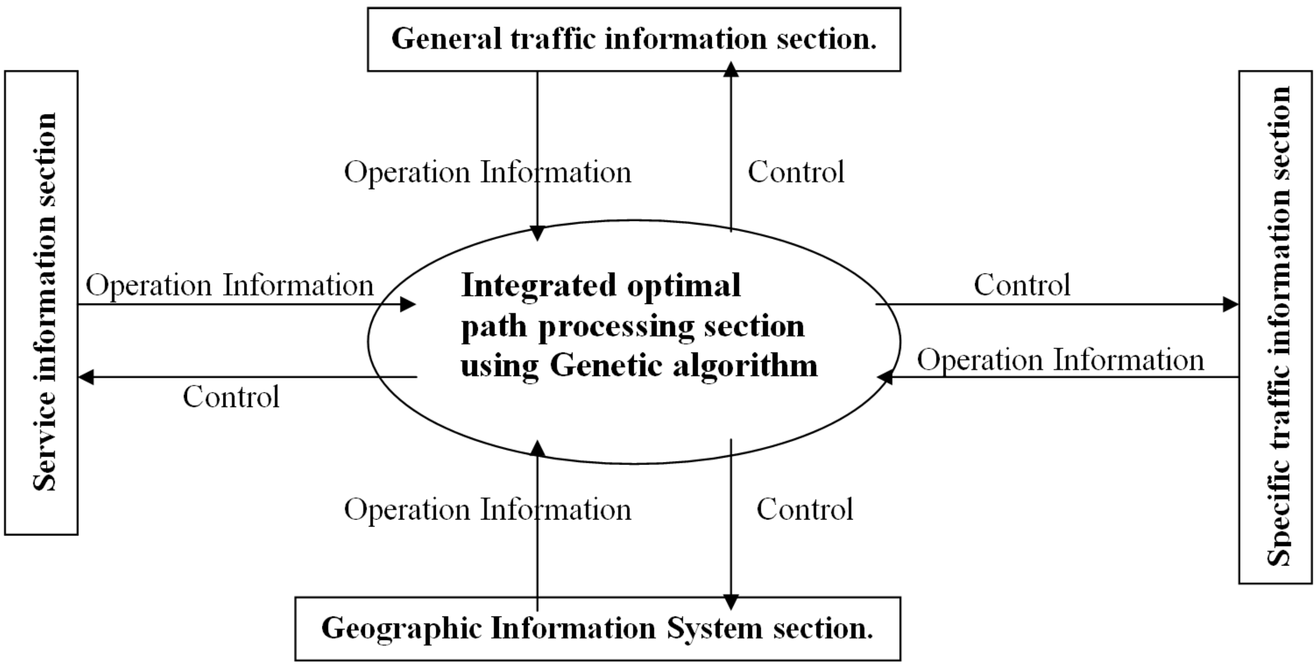

Figure 1. *The overall architecture of the AGTIS system.*

3.1. Integrated Genetic Optimal Path Processing Section[12-29]

An advanced Intelligent Traffic System using genetic algorithm has been constructed to find the optimal path between nodes and positions, the alternative solution(s) and to suggest optimal path to users. This part is implemented by shortest path algorithm that depends on the shortest distance between links and nodes as the main role to manage the shortest path algorithm. But to manage the optimal path, there are number of factors, such as minimum travel time, average speed, road setting, traffic volume, road light, road width, road length, traffic light, accidents, road-blocks, snow, and flooding.

The routing algorithm is widely used in many forms because it is simple and easy to understand. The idea is to build a graph of the subnet, with each node of the graph representing a router and each arc of the graph representing a communication line (often called a link). To choose a route between a given pair of routers[7-8],the algorithm finds the shortest path between them on the graph.

One way of measuring path length is the number of hops. Another metric is the geographic distance in kilometers(Miles), however, many other metrics are also possible but the physical distance is the best one. In the most general case, the labels on the arcs could be computed as a function of the distance and communication cost. By changing the weighting function, the algorithm would then compute the "shortest" path measured according to the physical distance criteria.

When the GENETIC ALGORITHM(GA) is implemented it is usually done in a manner that involves the following cycle:

1. Evaluate the FITNESS of all of the INDIVIDUALs in the POPULATION.
2. Fitness-proportionate REPRODUCTION.
3. Create a new population by performing CROSSOVER operations.
4. MUTATION, which occurs infrequently.
5. Discard the old population and iterate using the new population.

An Iteration of the previous loop is referred to as a GENERATION.

The first GENERATION (generation 0) of this process operates on a POPULATION of randomly generated INDIVIDUALs. From there on, the genetic operations, in concert with the FITNESS measure, operate to improve the population.

Given a way or method of *encoding* solution of a problem into the form of chromosomes and given an *evaluation function* that returns a measurement of the cost value of any chromosome in the context of the problem, a GA consists of the following steps (see Figure 2):

Step 1: Initialize a population of chromosomes.

Step 2: Evaluate each chromosome in the population; using a fitness *f*(i) which is assigned to each individual in the population, where high numbers denote good fit.

Step 3: Reproduction: The reproduction (parent selection) process is conducted by spinning a simulated biased roulette wheel whose slots have different sizes proportional to the fitness value of the individuals. This technique is called *roulette-wheel parent selection*.

Step 4: Crossover: Creating new chromosomes by mating current chromosomes, with a probability P*c*.

Step 5: Mutation: Is applied to get new bits in the population, with a low probability P*m*.

Step 6: If the stopping criterion is satisfied, then stop and return the best chromosome; otherwise, go to step 2.

Several algorithms for computing the shortest path are known. Our system is using genetic algorithm, where each node is labeled with its distance from the source node along the best known path.

To manage the optimal path, there are number of factors such as minimum travel time, average speed, road setting, traffic volume, road light, road width, road length, traffic light, accidents, road-blocks, snow and flooding. For example for the city of Amman in Jordan:

- If the time is between 7:30-9:30 am or 2:00-4:00 pm then the roads are busy.
- If there is a rain or snow then the roads may be slippery or dangers.
- If the number of traffic lights on a road is more than 4 then the travel time increases.
- If there are bridges, tunnels and traffic lights then the road is safe.

Figure 2. *The Flowchart For Short Path Routing Algorithm using Genetic Algorithm.*

3.2. General Traffic Information (GTI) Section

This section deals with static data related to links, nodes and roads connected between nodes and their cost (i.e. distance), and it supplies data to the optimal path processing section to begin process, as shown in Figure3.

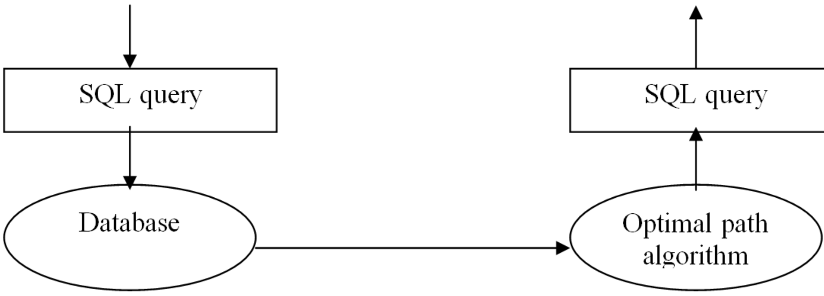

Figure 3. *The general traffic information part.*

3.3. Service Information Section

It performs the information queries, images for the most important service(such as hospitals, supermarkets, banks, schools and many other services) and shows the services according to the results of the optimal path processing that been chosen by the user.

3.4. Specific Traffic Information Section

It performs the traffic information queries, maps, images and traffic information's display, according to the results of the optimal path processing, and presents it to the user to choose the suitable path. Because the optimal solution that's produced by the algorithm might not be favored to the user. Therefore, the user can use one of the alternative solutions according to traffic information to help him making decision(s).

4. Project General Information System (GIS) Features

GIS system has close relationships with the other parts of AGTIS project. Major targets are offering convenient and powerful functions to operators and managers to handle input, output, map display and search for the traffic information. So every useful and diverse function in transparent manner is implemented with other information in Oracle.

GIS system consists of Oracle DBMS that manages the data in the system, which is very powerful to manipulate data. Because it performs the searching and analyses very fast, so it is suitable for the system. We carefully designed the database, because it is strongly related to the performance of the overall system as can be seen in Figure4.

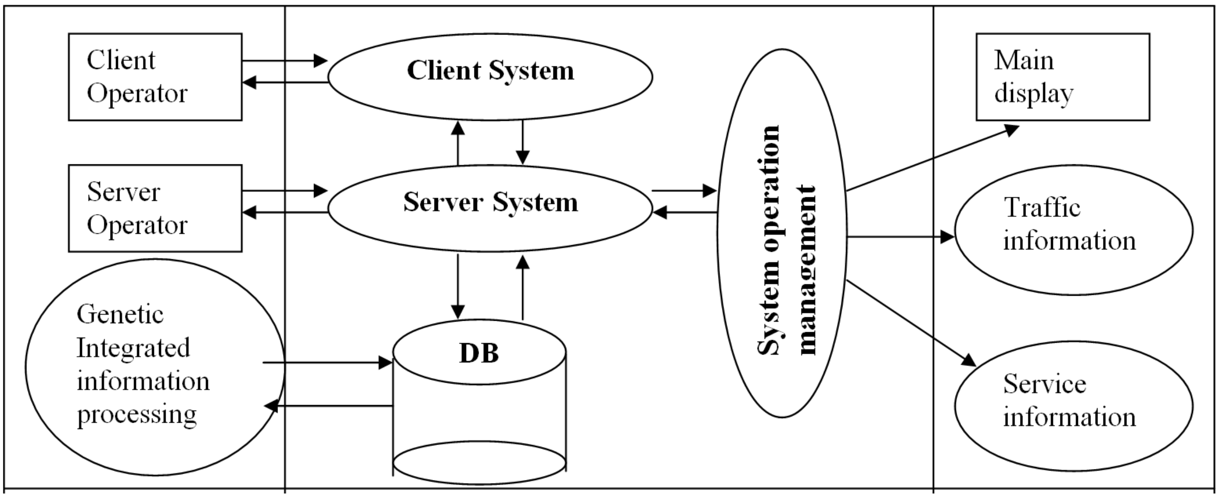

Figure 4. *GIS system architecture.*

5. Human Computer Interaction (HCI)

The prime focus of the (HCI) is how can the user make best use of the system to improve the safety, comfort, efficiency, and productivity of display screen work? This section shows how our understanding of (HCI) has shaped our design philosophy and how we have applied it by using some HCI standards and concepts such as list of values, text editing (editor), system navigators, colors, and other standers.

6. Internet Application

In the desired system, internet is the most important way to deliver the information to end-users. To support interactive application in web, java was chosen, because it is more suitable and portable in internet than other internet programming languages.

Search, special information listing, and optimal path finding in the internet service were considered. It's very interactive and friendly to users, and shows good performances and effective solutions, as can be seen in Figures 5 and 6.

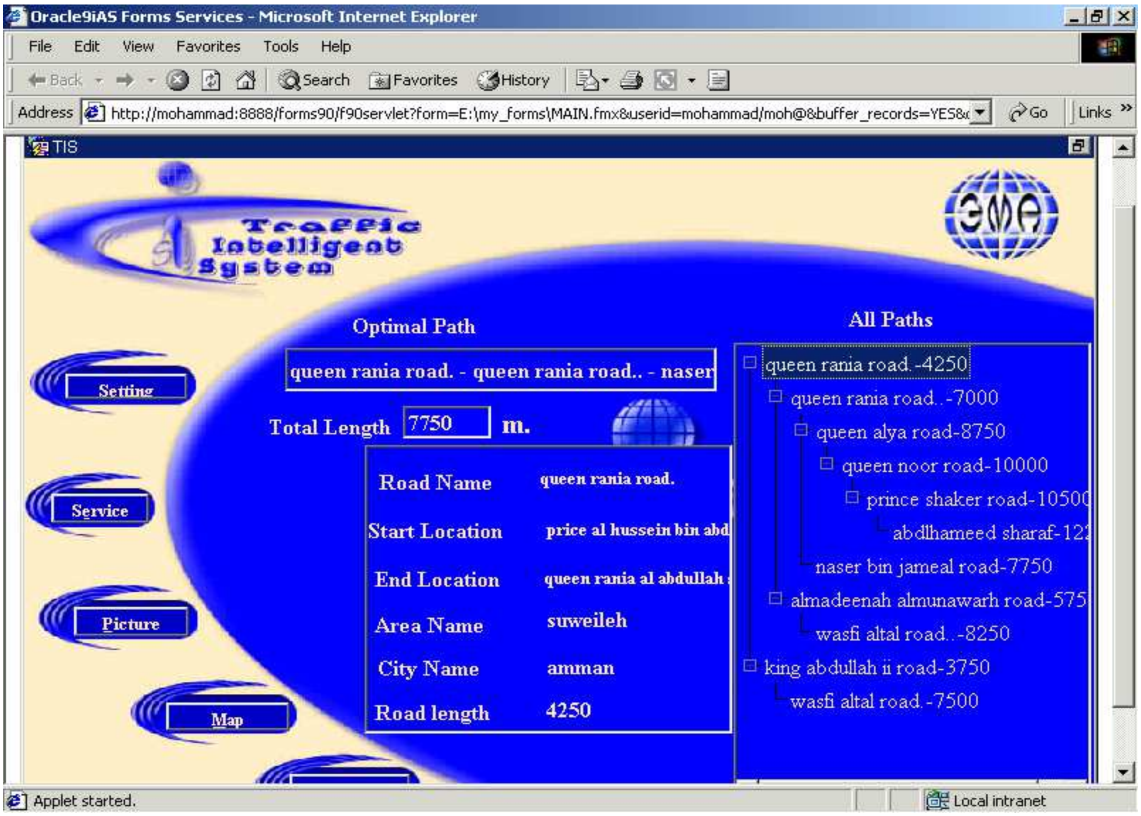

Figure 5. *Result of genetic optimal path.*

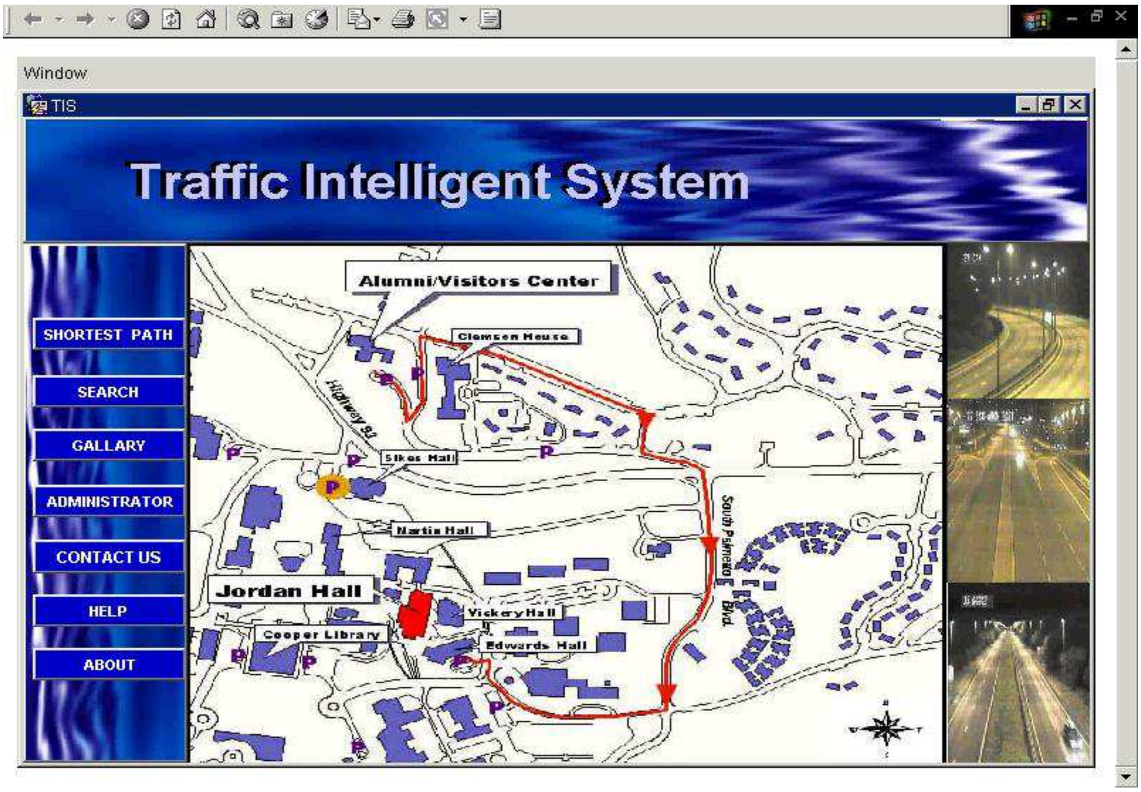

Figure 6. *The interface of the system.*

7. System Improvements

The presented system is advanced of the system presented in [30], since it has the following features:

- Using the network to manipulate data of large database in very efficient and fast way.
- Collecting every qualitative and quantitative real time traffic data and static data that is necessary to manage and maintain the real time data, by the sensors and detector and signal controller to deal with a dynamic process.
- Using the system in [30] as a base for a very powerful intelligent traffic and transportation system by managing dynamic geographical and transportation data efficiently.

8. Conclusions

An advanced system of [30] is presented. The Genetic Traffic Intelligent System(AGTIS) can make every journey more comfortable, safe, and less stressful. AGTIS helps to find the optimal path between two locations using the gathered data that has been stored in the database. The user can get the information he would like to receive through the system, such as optimal distance, minimum travel time, average speed, road setting, and many other different factors, the different options are calculated using SQL queries on the database and can easily be expanded. The implemented system shows efficient, active, scalable facilities, functions, and many other features in traffic intelligent environment. A freely flowing traffic creates less than slow-moving or stationary traffic**,** so our system which diverts travelers to less congested roads, helps in lowering the level of pollution.

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