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# Smart Route Optimization Intelligence for Transportation Algorithm

**Mahesh S*, Dhinesh S R, Mani Maran M, Kavi Arasan S, Dr. V. Subedha**

Department of Computer Science and Engineering, Panimalar Institute of Technology, Chennai, Tamil Nadu, India

## ABSTRACT

Every college in Tamil Nadu Government has a bus system. Because human work is involved in assigning the service to the students the end allocation is inaccurate and often leads to improper assigning of bus seats for the students. If this can be replaced by a machine automated algorithm the resources can be utilized effectively. The efficiency of a particular action increases exponentially when manual labour is replaced by automation. The product is projected towards bus transportation facility, with the SROIT algorithm automatically does efficient seat allocation for the students which makes sure every student is seated comfortably on their journey to and from the college. This project also makes sure that the natural resource (fuel) is utilized to the maximum extent and also ensures that the bus facility is allocated in an appropriate manner to avoid overcrowding of buses.

**Keywords :** Automation, SROIT

## I. INTRODUCTION

With the rapid development of global supply chain, containerized ocean transport has become the lifeline of almost any global supply chain. According to Page (2010), the carrier's service and on-time reliability become the most important factors in the contract between shippers and carriers and price becomes the third one.In order to ship cargoes to destination on time, freight schedule and route selection are very important because waiting caused by port congestion is the main factor according to Notteboom (2006) through data analysis of East Asia to Europe.Freight schedule will affect the arrival time of each port and number of ports or terminals are determined by planned route. The number of terminals a routes contained not only impact transport time of the whole container supply chain but also affect the carrier's profits through the utilization ofthe space of the ship.It is very difficult to improve the certainty of waiting time,choose a reasonable route and schedule are very important to improve the revenue and the service experience of a carrier. So in this paper we establish a mathematics model to optimize the schedule and route for a carrier to get the lowest cost and improve the service level as the same time.

## II. METHODS AND MATERIAL

### A. Literature Survey

1. Real-time video-based traffic measurement and visualization system for energy/emissions

B. T. Morris, C. Tran, G. Scora, M. M. Trivedi, and M. J. Barth

IEEE Trans. Intell. Transp. Syst., vol. 13, no. 4,pp. 1667-1678, Dec. 2012.

The ability to monitor the state of a given roadway in order to better manage traffic congestion has become increasingly important. Sophisticated traffic management systems able to process both the static and mobile sensor data and provide traffic information for the roadway network are under development. In addition to typical traffic data such as flow, density, and average traffic speed, there is now strong interest in environmental factors such as greenhouse gases, pollutant emissions, and fuel consumption. It is now possible to combine high-resolution real-time traffic data with instantaneous emission models to estimate these environmental measures in real time. In this

paper, a system that estimates average traffic fuel economy, $\hbox{CO}_{2}$, CO, HC, and $\hbox{NO}_{\rm x}$ emissions using a computer-vision-based methodology in combination with vehicle-specific power-based energy and emission models is presented. The CalSentry system provides not only typical traffic measures but also gives individual vehicle trajectories (instantaneous dynamics) and recognizes vehicle categories, which are used in the emission models to predict environmental parameters. This estimation process provides far more dynamic and accurate environmental information compared with static emission inventory estimation models.

2. Automated on-ramp merg-ing system for congested traffic situations

V. Milanes, J. Godoy, J. Villagra, and J. Perez

IEEE Trans. Intell. Transp.Syst., vol. 12, no. 2, pp. 500-508, Jun. 2011.

The constant population and economic growth has caused an enormous increase in the number of private cars in cities worldwide. Carpooling is one of the most effective solutions to traffic congestion. In this paper, an advanced carpool system is described in detail and called the intelligent carpool system (ICS), which provides users the use of the carpool services through a smart handheld device anywhere and at any time. To generate ride matches through the carpool service agency, we use the genetic algorithm to propose the genetic-based carpool route and matching algorithm (GCRMA) for this multi objective optimization problem called the carpool service problem (CSP). Use of the GCRMA was proved to result in superior results involving the optimization objectives of CSP than other algorithms. Furthermore, our GCRMA has small amount of computational complexity to response the match results in the reasonable time, and the processing time is further reduced by the termination criteria of early stop. The remaining of this paper is organized as follows: Section I contains introduction to carpool system, Section II presents related search, Section III describes two modules of ICS, Section IV contains carpool system problem (CSP), while Section V contains genetic based algorithm i. e. GCRMA.

3. Empty Seats Traveling

S. Hartwig and M. Buchmann

Nokia Research Center, Bochum, Germany, Feb. 2007.
In large cities, approximately 40 percent of fuel consumption is related to transportation. A noticeable amount of fuel is wasted due to traffic congestion in peak hours. Transportation planners look for policies to reduce congestion to save fuel and increase energy efficiency. Thus traffic congestion has been a serious problem in many urban areas around the world. One of the effective solutions to traffic congestion is carpooling that emphasizes on a shared use of private cars. In this paper, an advanced carpool system is described in detail, which provides carpoolers the use of the carpool services via a smart application anywhere and at any time.The main aim of the system is to develop a web-based application that enables people to use the facility of carpooling effectively. With the help of application, people can share the journey expense; make new connections by finding other people traveling through same desired route.

4. A fair carpool scheduling algorithm

R. Fagin and J. H. Williams

IBM J. Res. Develop., vol. 27, no. 2, pp. 133 139, Mar. 1983

Nowadays we encounter a lot of traffic congestion problems in cities and urban areas around the world. To minimize such problems carpooling can become and effective solution. Carpooling means increasing the occupancy rate of cars with a reduction in the number of empty seats in those vehicles. In this paper, we have presented an advanced carpooling system and described it in detail. This system can also be called as Intelligent Carpool System (ICS), which will provide the carpooling participants to use the carpool services using simple handheld smart devices anywhere and at any time. Here the carpooling service agency is equipped with abundant information about geographical, traffic and societal features and thus is used to handle user requests.For the coordination of the ride matches through the carpool service agency, we have applied the genetic algorithm approach and proposed the genetic based carpool route and matching algorithm (GCRMA) for this multi-objective optimization problem called the carpool service problem (CSP).The GCRMA has a significantly small

amount of computational complexity used to match the response in the match results and also reduced processing time by including the termination criteria called as early stop.

5. Automated wireless carpooling system for an eco-friendly travel

R. K. Megalingam, R. N. Nair, V. Radhakrishnan, and A. V. Vidyapeetham

Elec-tron. Comput. Technol., vol. 4, pp. 325 329, Apr. 8 10, 2011.

There has been rapid industrialization and urbanization in the recent past. Due to this increasing pace, a lot of problems like traffic congestion have come to the fore. The harmful effects of traffic congestion are not unfamiliar to many.To ease and mitigate this traffic congestion issue, Carpooling has come out as a decent solution. Carpooling helps to increase the occupancy rates of the car, enabling extra users to be accommodated in the same vehicle, and thus contributing towards the traffic congestion issue. This paper proposes an Intelligent Carpool System called ICS and also describes the costing charges applied on the passengers enjoying carpooling services. According to this system, drivers and passengers can access the Carpool services exercised by the carpool agency through their simple handheld devices. The driver and passenger matching is done via the Genetic carpool route and matching Algorithm called GCRMA. The costs mentioned above which will be charged for the passenger will be calculated via the Haversine Formula.

6. Dynamic ride-sharing: A simulation study in metro Atlanta

N. Agatz, A. L. Erera, M. W. P. Savelsbergh, and X. Wang

Transp. Res. B, Methodol.,vol. 45, no. 9, pp. 1450 1464, Nov. 2011.

Ride-sharing services are transforming urban mobility by providing timely and convenient transportation to anybody, anywhere, and anytime. These services present enormous potential for positive societal impacts with respect to pollution, energy consumption,congestion, etc. Current mathematical models, however, do not fully address the potential of ride-sharing. Recently, a large-scale study highlighted some of the benefits of car pooling but was limited to static routes with two riders per vehicle (optimally) or three (with heuristics). We present a more general mathematical model for real-time high-capacity ride-sharing that (i) scales to large numbers of passengers and trips and (ii) dynamically generates optimal routes with respect to online demand and vehicle locations. The algorithm starts from a greedy assignment and improves it through a constrained optimization, quickly returning solutions of good quality and converging to the optimal assignment over time. We quantify experimentally the tradeoff between fleet size, capacity, waiting time, travel delay, and operational costs for low- to medium-capacity vehicles, such as taxis and van shuttles. The algorithm is validated with ~3 million rides extracted from the New York City taxicab public dataset. Our experimental study considers ride-sharing with rider capacity of up to 10 simultaneous passengers per vehicle. The algorithm applies to fleets of autonomous vehicles and also incorporates rebalancing of idling vehicles to areas of high demand. This framework is general and can be used for much real-time multivehicle, multitask assignment problems.

7. A Spatial Approximate String Queries To Solove Issuses in Carpool Services Using Mhr-Tree In Cloud

R. Prasanthini, Dr.K.Kavitha

The continuous population and economic growth have caused a massive increase in the number of private cars in cities worldwide. Carpooling is the sharing of car journeys so that more than one person travels in a car.Carpooling reduces each person's travel costs such as fuel costs, tolls, and the stress of driving. In a city area, there are the different option are available for public transportation but there is the disadvantage of comfort level. In this paper, we have presented an advanced carpooling system and described it in detail. This system can also be said as intelligent Carpool System (ICS), which will give the carpooling participants to use the carpool services using simple handled smart devices anywhere and at any time. .It is significant to develop algorithmic methods for optimally matching drivers and passengers on the service agency of the ICS system. To give system users

the opportunity to obtain carpool matches any place and at any time, drivers and passengers similar can use the MC module to execute carpool operations (e.g., requesting and offering the ride) via their mobile devices. MHR tree, for efficiently answering approximate string match query in large spatial databases.

8. A genetic and insertion heuris-tic algorithm for solving the dynamic ride matching problem with time windows

W. M. Herbawi and M. Weber in Proc. ACM Int. Conf. Genetic Evol. Comput., 2012,pp. 385 392.

Recently, rates of vehicle ownership have risen globally, exacerbating problems including air pollution, lack of parking, and traffic congestion. While many solutions to these problems have been proposed,Carpooling is one of the most effective solutions to this problems Recently, several carpooling platforms have been built on cloud computing systems, with originators posting online list of departure/arrival points and schedules from which participants can search for rides that match their needs. In this paper, an improved carpool system is described in detail and called the improved intelligent carpool system (IICS), which provides car poolers the use of the carpool services via a smart handheld device anywhere and at any time. This IICS Consist the geographical, traffic, and societal information and used to manage requests and find minimum route. We apply advanced genetic-based carpool route and matching algorithm (AGCRMA) for this multiobjective optimization problem called the carpool service problem (CSP).

9. Binary-representation-based genetic algo-rithm for aircraft arrival sequencing and scheduling

X. B. Hu and E. Di Paolo

IEEE Trans. Intell.Transp. Syst., vol. 9, no. 2, pp. 301 310, Jun. 2008.

Arrival sequencing and scheduling (ASS) at airports is an NP-hard problem. Much effort has been made to use permutation-representation-based genetic algorithms (GAs) to tackle this problem, whereas this paper attempts to design an efficient GA based on a binary representation of arriving queues.Rather than using the order and/or arriving time of each aircraft in the queue to construct chromosomes for GAs, this paper uses the neighboring relationship between each pair of aircraft, and the resulted chromosome is a 0-1-valued matrix. A big advantage of this binary representation is a highly efficient uniform crossover operator, which is normally not applicable to those permutation representations. The strategy of receding horizon control (RHC) is also integrated into the new GA to attack the dynamic ASS problem.An extensive comparative simulation study shows that the binary-representation-based GA outperforms the permutation-representation-based GA.

10. Optimization of transit priority in the transportation network using a genetic algorithm

M. Mesbah, M. Sarvi, and G. Currie

IEEE Trans. Intell.Transp. Syst., vol. 12, no. 3, pp. 908 919, Sep. 2011.

Transit signal priority has a positive effect on improving traffic condition and level of transit service in the urban area. In this paper, a passenger-based transit signal priority (TSP) optimization model is formulated to optimize intersection signal phasing based on minimizing 0accessibility-based passenger delay at the intersection and increased waiting-delay at the downstream bus stop simultaneously. Genetic Algorithm is utilized to calculate passenger-based optimization model that is calibrated by evening rush hour actual traffic data (17:30 18:30, October 13th October 15th, 2015) along Shuiximen Boulevard in Nanjing, China. The performance of the proposed optimization model in decreasing delay and improving system reliability is simulated and evaluated by VISSIM-based simulation platform, and the results illustrate that the proposed optimization model presents promising outcomes in decreasing accessibility-based passenger delay at intersection (average reduction of 12%) and passenger waiting-delay at downstream bus service stop (average reduction of 18%) compared with traditional vehicle-based TSP optimization method in rush hour.

11. Application of genetic algorithms to solve the multidepot vehicle routing problem

H. C. W. Lau, T. M. Chan, W. T. Tsui, and W. K. Pang

IEEE Trans. Autom. Sci. Eng., vol. 7, no. 2, pp. 383 392, Apr. 2010.

This paper deals with the optimization of vehicle routing problem in which multiple depots, multiple customers, and multiple products are considered. Since the total traveling time is not always restrictive as a time window constraint, the objective regarded in this paper comprises not only the cost due to the total traveling distance but also the cost due to the total traveling time. We propose to use a stochastic search technique called fuzzy logic guided genetic algorithms (FLGA) to solve the problem. The role of fuzzy logic is to dynamically adjust the crossover rate and mutation rate after ten consecutive generations. In order to demonstrate the effectiveness of FLGA, a number of benchmark problems are used to examine its search performance. Also, several search methods, branch and bound, standard GA (i.e., without the guide of fuzzy logic), simulated annealing, and tabu search, are adopted to compare with FLGA in randomly generated data sets. Simulation results show that FLGA outperforms other search methods in all of three various scenarios.

12. A genetic algorithm for shortest path routing problem and the sizing of populations

C. W. Ahn and R. S. Ramakrishna

IEEE Trans. Evol.Comput., vol. 6, no. 6, pp. 566 579, Dec. 2002.

This paper represents a genetic algorithmic approach to the congestion-aware routing problem in Mobile Ad hoc Networks. Variable-length chromosomes (strings) and their genes (parameters) are the sources for encoding the problem. The crossover operation exchanges partial chromosomes (partial routes) and the mutation operation maintains the genetic diversity of the population. The proposed congestion-aware routing fitness function algorithm is capable of curing all the infeasible chromosomes with an adaptive repair function. The congestion aware fitness function gives an improved quality of solution and enhanced rate of convergence. The performance metrics throughput, packet delivery ratio and delay are taken into account for computer simulations which shows the proposed algorithm exhibits a much better quality of solution (congestion-aware routing) and a much higher rate of convergence than other conventional algorithms in mobile ad hoc networks.

13. Evaluating a Service-Oriented Architecture

P. Bianco, R. Kotermanski, and P. Merson

Software Engineering Institute, Pittsburgh, PA,USA, CMU/SEI-2007-TR-015, Sep. 2007.

The emergence of service-oriented architecture (SOA) as an approach for integrating applications that expose services presents many new challenges to organizations resulting in significant risks to their business. Particularly important among those risks are failures to effectively address quality attribute requirements such as performance, availability, security, and modifiability. Because the risk and impact of SOA are distributed and pervasive across applications, it is critical to perform an architecture evaluation early in the software lifecycle. This report contains technical information about SOA design considerations and tradeoffs that can help the architecture evaluator to identify and mitigate risks in a timely and effective manner. The report provides an overview of SOA, outlines key architecture approaches and their effect on quality attributes, establishes an organized collection of design-related questions that an architecture evaluator may use to analyze the ability of the architecture to meet quality requirements, and provides a brief sample evaluation.

14. Intelligent dynamic programming for the generalised trav-elling salesman problem

O. Jellouli

Proc. IEEE Int. Conf. Syst., Man, Cybern.,2001, vol. 4, pp. 2765 2768.

This paper deals with the optimization of the capacity of a terminal railway station using the Ant Colony Optimization algorithm. The capacity of the terminal station is defined as the number of trains that depart from the station in the unit interval of time. The railway capacity optimization problem is framed as a typical symmetrical Travelling Salesman Problem (TSP), with the TSP nodes representing the train arrival /departure events and the TSP total cost representing the total time interval of the schedule. The application problem is

then optimized using the ACO algorithm. The simulation experiments validate the formulation of the railway capacity problem as a TSP and the ACO algorithm produces optimal solutions superior to those produced by the domain experts.

15. Beyond Bellman's principle of optimality: The principle of real-time optimality

C. D. Johnson

Proc. Southeastern Symp. Syst. Theory,Mar. 20 22, 2005, pp. 326 335.

Recently, rates of vehicle ownership have risen globally, exacerbating problems including air pollution, lack of parking, and traffic congestion. While many solutions to these problems have been proposed, Carpooling is one of the most effective solutions to this problem Recently, several carpooling platforms have been built on cloud computing systems, with originators posting the online list of departure/arrival points and schedules from which participants can search for rides that match their needs. In this paper, an improved carpool system is described in detail and called the improved intelligent carpool system (IICS), which provides car poolers the use of the carpool services via a smart handheld device anywhere and at any time. This IICS Consist the geographical, traffic, and societal information and used to manage requests and find a minimum route. We apply advanced genetic-based carpool route and matching algorithm (AGCRMA) for this multiobjective optimization problem called the carpool service problem (CSP).

16. On low-complexity maximum-likelihood decoding of convolutional codes

J. Luo

IEEE Trans. Inf. Theory, vol. 54, no. 12, pp. 5756 5760,Dec. 2008.

This letter considers the average complexity of maximum-likelihood (ML) decoding of convolutional codes. ML decoding can be modeled as finding the most probable path taken through a Markov graph. Integrated with the Viterbi algorithm (VA), complexity reduction methods often use the sum log likelihood (SLL) of a Markov path as a bound to disprove the optimality of other Markov path sets and to consequently avoid exhaustive path search. In this letter, it is shown that SLL-based optimality tests are inefficient if one fixes the coding memory and takes the codeword length to infinity. Alternatively, optimality of a source symbol at a given time index can be testified using bounds derived from log likelihoods of the neighboring symbols. It is demonstrated that such neighboring log likelihood (NLL)-based optimality tests, whose efficiency does not depend on the codeword length, can bring significant complexity reduction. The results are generalized to ML sequence detection in a class of discrete-time hidden Markov systems.

17. Applying the attribute based hill climber heuristic to the vehicle routing problem

U. Derigs and R. Kaiser

Eur. J. Oper. Res., vol. 177, no. 2,pp. 719 732, Mar. 2007.

Recently, rates of vehicle ownership have risen globally, exacerbating problems including air pollution, lack of parking, and traffic congestion. While many solutions to these problems have been proposed, Carpooling is one of the most effective solutions to this problem Recently, several carpooling platforms have been built on cloud computing systems, with originators posting the online list of departure/arrival points and schedules from which participants can search for rides that match their needs. In this paper, an improved carpool system is described in detail and called the improved intelligent carpool system (IICS), which provides car poolers the use of the carpool services via a smart handheld device anywhere and at any time. This IICS Consist the geographical, traffic, and societal information and used to manage requests and find a minimum route. We apply advanced genetic-based carpool route and matching algorithm (AGCRMA) for this multiobjective optimization problem called the carpool service problem (CSP).

18. Spatial characteristics of the residents commuting behavior in Beijing

B. Meng, L. Zheng, H. Yu, and G. Me

Proc. IEEE Int. Conf. Geoinf.,Jun. 2011, pp. 1 5

Residential self-selection has been reported to be a factor confounding the observed relationship between built environment and travel behavior. By incorporating residential self-selection, studies have generated much insight into the causalities involved in the relationship between built environment and travel behavior. However, most of these studies were conducted in North American cities, where individuals may have the opportunity to realize their preferences in residential and transport mode choices. There are not many similar studies for other parts of the world, such as China, where residential and transport choices are probably more constrained than in North America. This paper aims to partly fill the gap by discussing the specificities of the residential self-selection issue in urban China and suggesting how to cope with this issue when examining the relationship between built environment and travel behavior in the Chinese context. We argue that studies addressing the residential self-selection issue in China need to consider the housing source, which has implications for residential choice and acknowledges the importance of some travel-related attitudes such as preferences for short commutes, good accessibility to public transport, and proximity to markets for daily goods shopping.

Genetic algorithm approach to solve routing problem.The proposed idea is to generate routes for a college bus transit network which deviates from the point to point network and the related routing. Genetic Algorithms, are known to be a robust optimization method for this type of problem and used to solve the routing problem. The genetic algorithm includes steps like the assignment of traffic on developed feeder routes.Development of the objective function and their constraints, finding the penalized objective function and applying the Genetic Algorithm to determine optimal frequencies on different routes for minimum penalized objective function. The genetic algorithm method is different from another search methods where it searches among a population of points and works with a coding of parameters, rather than within the parameter values.

## B. Advantages

- Automation: Human Work is replaced by an Algorithm
- Fuel Consumption is Minimized
- Outcome is Accurate so none of students will be standing in their journey

## C. Modules

### Dataset Collection

The student and staff details are collected from the college and stored in the database. The boarding points and the names of the student and staff members are extracted from the database. The extracted data are stored in the xml format and are given as an input to the Geocoder which converts the XML file into KML .Where the kml file consist of exact coordinates forthe given boarding point of the students and staff. Those coordinates are then marked on the map with the help of map marker tool.

### Direction Specification

After marking the coordinates on the map, then comes the bus part where the number of buses which are going to be operated are specified. Then based on the number of buses, the direction in which the bus is going to travel are allocated. In the specified direction the buses travel, by covering the nodes in that direction.

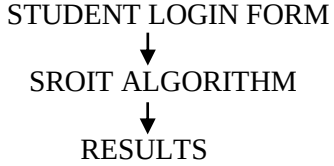
### Checking Availability

Checking the availability of the students and staff members in each direction along which the bus is assigned to travel. If the demand of boarding point in one direction is more than the other, then corresponding no of buses will be assigned to that direction. No of buses are therefore decided to assign by considering the no of students available in each route.

### Route Allocation

Assigning the routes and the boarding point in which the bus is going to travel and pick up the students. This process is done in two ways as per the no of busses traveling in the same direction. That is if two buses are assigned to travel in the same direction then intermediate node allocation will be followed or if a single bus is assigned to travel in one direction then normal routing process will be carried out accordingly. The time in which the bus starts from the starting point is also assigned.

## D. Architecture



## III. RESULTS AND DISCUSSION

**Table 1.** Bus In Charge Result Page

| BUS NUMBER | STUDENTS |
|---|---|
| Route 1 | Members Count |
| Route 2 | Members Count |

**Table 1.** Student Result Page

| STUDENT NAME | BUS NUMBER |
|---|---|
| NAME 1 | BUS NO |
| NAME 2 | BUS NO |

### A. Output Obtained

There are various outputs obtained as a result. They are student bus pass, student list which includes names of the students allotted to travel in a particular bus and also the boarding point in which the bus needs to board and the route the bus needs to travel are determined.

### B. Expected Outcome

- The expected outcomes
- The routes will be generated for each and every bus along with the stops.
- The student and staff lists will be generated for a particular bus.
- The bus pass will be generated for every student with necessary details.

## IV. CONCLUSION

The proposed idea intends to generate an effective routing model for the college with ease to access reducing any manual work. The output reduces the travelling time and ensures the even distribution of buses in all the route with a balanced load in each bus. With the application of a robust algorithm like genetic approach,the selection of optimal route from a set of possible routes is achieved.

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