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Route Allocation for College Bus Transit Network with Balanced Load

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***Abstract*—** Bus routing is the process of selecting best paths in a network. A college bus transport needs a system that helps in effective routing with a balanced load. The existing works are based on the hub and spoke model which mainly concentrates on point to point bus transit network. This paper deals with allocating bus route by locating the boarding points of students with the help of Google maps. The Direction Oriented Routing (DOR) is based on the available number of students on each possible direction. The nodes allocated for bus routing in done in two ways, they are Intermediate Route Allocation (IRA) and Default Route Allocation (DRA). IRA is used for special cases and DRA is used for normal cases. This system generates an effective, balanced load and average timed bus routing.

***Keywords*—** Hub and Spoke Model, Direction Oriented Routing, Intermediate Route Allocation, Default Route Allocation

I. INTRODUCTION

The bus transport system plays a major role in a college where the college has also been chosen based on the availability of bus in their own locality and the students in the bus are free enough to have a seat and making sure that there is no congestion in bus .Now a days students come to college even from remote villages. So the bus facility must be available for easy transportation of students. To overcome this problem this project concentrates on a network which covers intermediate nodes. Maintain the capacity of all the buses that has to be filled equally and find optimal route when having more alternative routes.

II. LITERATURE REVIEW

A. Development of a Hub and Spoke Model for Bus Transit Route Network Design

[3] For a large city bus transit service, a point to point route network, attempting to connect each node to every other node results in large number of routes in the network which makes it practically very complex to understand and operate the services. To overcome these limitations a different transit network design approach is required. A combination of traditional destination oriented routes along with direction oriented routes, which is called as Hub and Spoke network could be better for operating bus transit in large network. Previous research works done using hub-and-spoke model mainly concentrates on airline network, where the influencing factors and variables for network design could be substantially different than transit network. This paper presents an approach to develop hub and spoke route network for bus transit services. Whole process consists of obtaining potential hubs, finding optimum location of hubs and allocation of non-hub nodes to hub nodes, generating inter hub and intra -hub routes and their frequencies for running buses .The model developed in the study of Mandl's Swiss network of fifteen nodes. The Mandl's network is mostly used by many researchers to analyze their models developed for point to point bus transit route network. The results suggest noticeable savings in operator cost along with slight increase in user cost.

B. Auctioning Bus Routes: The London Experience

[1] The London bus routes market provides an early example of the use of a combinatorial auction format in public procurement. This market covers about 800 routes serving an area of 1,630 square kilometers and more than 3.5 million passengers per day. It is valued at 600 million Pounds per year (roughly US $900 million).

In order to enhance competition, The operational division, London Buses Limited, was split into 12 operational subsidiaries.

First, we describe the combinatorial auction format adopted by LRT and briefly discuss its properties. Second, we describe the bidding patterns observed in the data that we collected for these auctions, with a special emphasis on package bidding and the effect of the auction size

Finally, as in any practical design problem, LRT was faced with a range of options when deciding on the auction format. A critical input into any such analysis is a better understanding of bidders' preferences, i.e., in our case, their cost structure. Non-tendered routes remained operated by the subsidiaries of London Buses Limited under a negotiated block grant. The private operators and the subsidiaries competed for the tendered services. summarize a new method that we have developed to analyze bid data from combinatorial first price auctions to do exactly this: infer bidders' cost structure. We illustrate this method and discuss our findings.

C. School Bus Routing and Scheduling using GIS

[2] School bus routing and scheduling are among the major problems because school bus transportation needs to be safe, reliable and efficient. Hence, the research question for this thesis is to answer how to transport students in the safest, most economical and convenient manner. The

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objective of this thesis is to create a GIS based school transport management system which helps in bus-stop allocation, design fastest and safest bus routes with AVL facility. This thesis also aims to investigate how a school transportation management system may improve the transportation security. The result from this study has helped to develop a school bus routing and scheduling prototype model for Sujatha High School, Hyderabad. This prototype model will help the school transportation management to design shortest and fastest school bus routes and they can also allocate bus stops, which will help them in selecting the pick-up stops for the students and staff, according to their concentration in the areas. This thesis has also, through literature study, investigated how a school transport management system can improve the transportation security. For the time being, there is a general belief that ICT contributes to improving the security, although a quantification of such improvements are lacking. The user interface application has been developed by using VBA and Arc GIS 9.1 Network Analyst provided by Environmental Science Research Institute and it has been evaluated by GIS users.

III. Existing Approach

A. Hub and Spoke approach

A transport network may be represented as a set of links and a set of nodes. A link connects two nodes and a node connects two or more links. Links may be either directed or undirected. The point to point network is a destination oriented network and this type of transit network in a large city is very complex to understand, inefficient and also difficult to operate. A combination of traditional destination oriented along with direction-oriented approach, called Hub and Spoke network, is best suited for such type of large networks. A hub and spoke network aggregates multiple origin flows at a single hub node where the high volume aggregated flows travels from one hub to another via a hub-hub link, all hub nodes are assumed to be inter connected. Arriving at the second hub node the flow then gets split up and sorted to flow to each of its respective destination nodes. The routing through hubs takes advantage of economies of scale on inter hub links. Although this may increase travel distance or time, it decreases travel cost. Economies of Scale, economies of Scope, network coverage, seamless connection for passenger travel, reduced fleet size are the advantages of hub and spoke network.

IV. Proposed Approach

A. 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. Genetic algorithm includes steps like 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 other search methods where it searches among a population of points and works with a coding of parameters, rather than within the parameter values.

V. Modules

A. 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 for the given boarding point of the students and staff. Those coordinates are then marked on the map with the help of map marker tool.

B. 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.

C. 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.

D. 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.

E. 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.

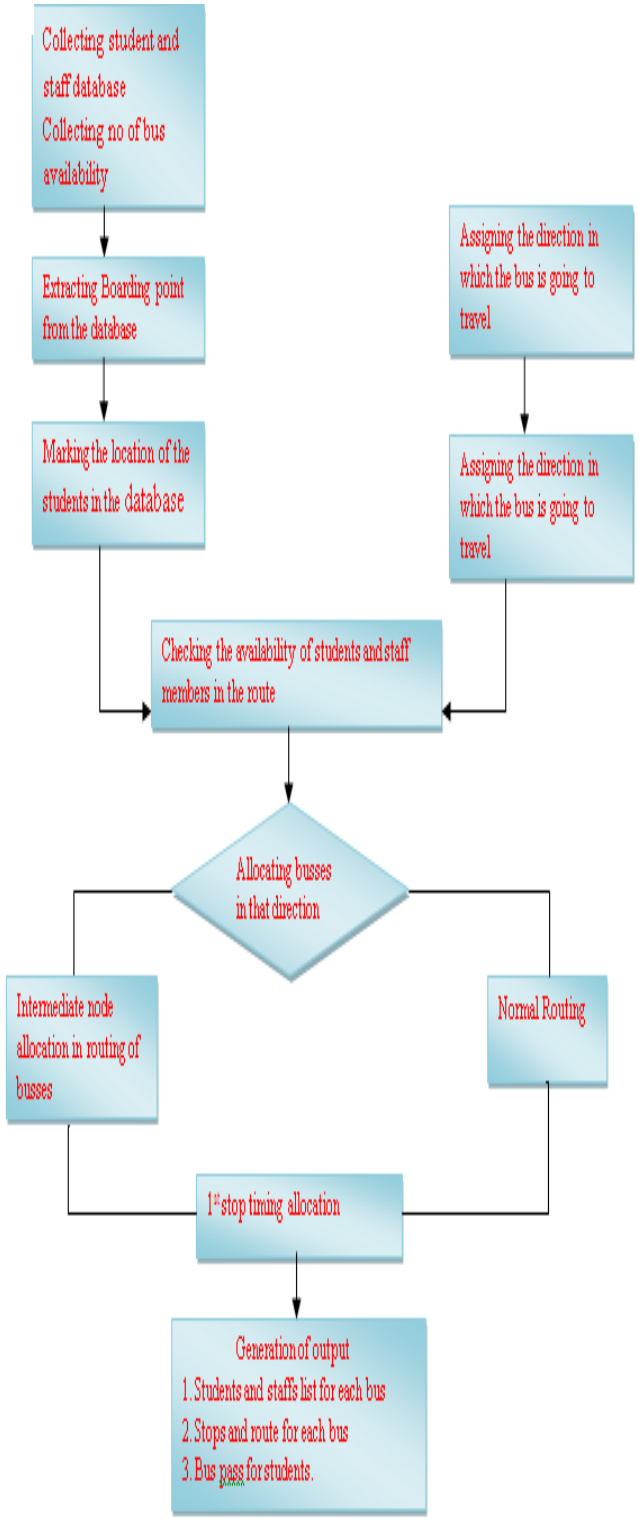

Figure 1: overall data and process flow.

VI. Expected Outcome

The expected outcomes are

- 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.

	A	B	C	D	E	F	G
1	Reg_No	Name	Dept	DOB	Year	Address	stop
2	6.17E+11	gowthami	CSE	31/10/93	2016	107,narayana pillai street,permanoor salem-636007	peramanoor
3	6.17E+11	praveen	ECE	18/04/92	2016	22,chairman sadagopher street,ammapet,salem-636001	ammapet
4	6.17E+11	vignesh Rajan	EEE	12/05/94	2016	9/5,kannapa nainaur street,omalur-636502	omalur busstand
5	6.17E+11	Ariki Priya	IT	21/03/94	2016	6-21,power grid colony,K.R.thoppur,salem-636502	thoppur
6	6.17E+11	Rathi Priya	MECH	13/12/93	2016	4/167,parakkadu,kandhasramam(po),salem-636140	kandhasramam
7	6.17E+11	siva	CSE	29/06/93	2016	kulandai gounder kattu valavu,mookkanur(po),omalur(tk)-636455	omalur busstand
8	6.17E+11	jeevaksalan	ECE	19/12/92	2016	14,A udayar(Azad)street,first agraharam,salem	oldbusstand
9	6.17E+11	shakthi	EEE	01/04/93	2016	golden street,kambainallur(po),dharmapuri	dharmapuri
10	6.17E+11	murugan	IT	13/08/94	2016	poosaripatty(po) old cinema theatre,omalur-636455	omalur busstand
11	6.17E+11	logeshwari	MECH	04/11/94	2016	14/116-jageer venkatapuram mel somanpetti,krishnagiri-635001	omalur busstand
12	6.17E+11	saranya	CSE	06/09/94	2016	first floor,near VAO office,poosaripatty,omalur(tk),salem(dt)-636305	omalur busstand
13	6.17E+11	sowmya	ECE	24/03/94	2016	47/D2,kurinji apartments,johnsonpet road,near LIC divisional office,Salem-636007	gandhi road
14	6.17E+11	nandhini	EEE	26/11/94	2016	8/5-B,jothi theatre east street,ammapet,salem-636003	ammapet
15	6.17E+11	brindha	IT	11/11/94	2016	1/36A,nadar street,mallamoopampatty,jyyemperumampatty(po),salem-636302	neikkarapatti
16	6.17E+11	santhiya	MECH	28/09/92	2016	4/393,karuvattukaran kottai,poosaripatty(po),omalur(tk),salem(dt)	omalur busstand
17	6.17E+11	kavitha	CSE	17/08/94	2016	45,shenna krishnan street,shevapet,salem-636002	shevapet

Figure2: Dataset Collection

VII. 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 routes 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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