

AN EFFICIENT AND COST EFFECTIVE PUBLIC BUS TRANSPORTATION TIMETABLING ROUTING AND DRIVER DUTY SCHEDULING USING MATLAB

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Abstract

This paper will provide guidelines for bus planning operators to develop an efficient and cost-effective Public bus Transportation route and schedule in MATLAB software. The main objective of public transport planning is to optimize the operational cost on the entire network. Then, its profit, level of service and competitiveness can be improved. Bus service scheduling and driver duty scheduling have done in Matlab where scheduling of up to 5000 drivers can be done. This Project will provide guidelines to find the Bus Network Flow Graph for hundreds of Buses. It also Provides the shortest path (Based on Distance, Cost) several through the Entire Network of flow Graph.

Keywords: Bus Network Flow Graph, Shortest Path Problem, Network-Model, Vehicle Routing problem (VRP),

I. INTRODUCTION

The buses and trains play a very important role in public road transportation system. There is a great need of having user & transit friendly transportation system. In public transportation system there is one depot node and others are sub depot nodes (where pickup & drop up of passengers has been take place). so in order to become Public bus transportation more economical and environment friendly, it is required to have the most optimal planning in bus transportation.

In transportation problems, if the size of transportation route has been reduced then it leads to considerable reduction in relative cost. So it is budget saving for transportation company. Since it is directly related with fuel consumption

The aims of this scheduling method are: (i) to make best use of the drivers, assets and financial resources; (ii) to improve the on road vehicle efficiency; (iii) to optimize route, operational cost.

Thus there is need of Research & Development in timetabling, routing and scheduling of vehicles in public transportation. So that it will meet to the Passenger's trip demands. This problem has been remarked by many public transportation experts all around the world. For the any Bus Depot, the main objective of public transport planning is to optimize the operational cost on the entire network. Then, its profit, level of service and competitiveness can be improved. Planning of public transport is one of the issues which use the bus routing method. Stations having hundred, and upto thousand, Buses on each day are common throughout

Maharashtra. So these Bus station have more number of intermediate Routes, which are connected to the sequential stopping points (stations). The Buses differ in their categories, running speed, departure time and arrival time, starting point and destinations.

The advantage of having transportation system with an automation is that such transportation system gives an efficient schedules, it will reduce the driver duty time for duty scheduling, it gives optimum solution for transportation problem.

Therefore there is need of research in the timetabling, planning and scheduling of buses. The planning and scheduling is highly complex problem

II. LITERATURE ON RELATED WORKS

Various methods are proposed for the vehicle routing problem. Jing-Quan Li [4] introduces many methods for solving the vehicle routing problem. The Bus Depot Platform allocation and routing can be done using different schemes.

Park and Kim (2010) [7] presents proper schedule for a allocation of buses where every bus picks up student from various bus stops and then drop them to the school.

III. PROPOSED WORK

Through analysing different methodologies, this project will provide guidelines for bus planning operators to develop an efficient and cost-effective Public bus Transportation route and schedule. Since finding the optimization for this

problem manually is very tedious task also it requires large computation time. It is possible to solve shortest path problem in Matlab.

A. Reading Xls Sheet into Matlab Software.

Implementation for accessing the database from excel to matlab can be performed by using two different approaches

- Excel sheet data can be used as an intermediate data. Using Matlab and Computer languages like C, C++ it is possible to access the given database.

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ABC Trip Report For The Month July 2013 For The Route Ty

	A	B	C	D	E	F	M	N	Q	R	S	T	
1		CASE STUDY DATA FILES (ISLAMPUR DEPOT) :-											
		Maharashtra State Road Transport Corporation											
2		Division Name : SANGLI					Depot Name : ISLAMPUR						
3		ABC Trip Report For The Month July 2013 For The Route Type All For The Bus											
4		Type All											
5													
6		SrNo	Route	DU.NO.	Time	Dist.	Trips	K.M.	Earn.	EP/KM	L.F.	N.EP/KM	Gr
7		1	SANGLI SHIRDI	4	5.45	431.7	31	13383	393824	29.4272	69.74	24.2774	B
8		2	SHIRDI SANGLI	5	5.45	431.7	31	13383	397948	29.7353	70.47	24.5317	B
9		3	SANGLI NASIK	6	10	452.3	31	14021	420461	29.9879	71.19	24.7401	B
10		4	NASIK SANGLI	7	7.3	452.3	31	14021	414144	29.5374	70.12	24.3684	B
11		5	ISLAMPUR AKKALKOT	29	11	293.7	31	9105	267986	29.4328	69.67	24.2821	B
12		6	AKKALKOT ISLAMPUR	30	6.45	293.7	31	9105	224377	24.6433	58.33	20.3307	B
13		7	ISLAMPUR TULIAPUR	34	10.15	300.1	31	9303	270997	29.1301	69.98	24.0323	B
14		8	TULIAPUR ISLAMPUR	35	7	300.1	31	9303	226299	24.3254	57.6	20.0684	B
15		9	ISLAMPUR MUMBAI (CEN.)	137	10	352.9	31	10940	264198	24.1497	57.3	19.9235	B
16		10	MUMBAI (CEN.) ISLAMPUR	138	7.3	352.9	31	10940	233480	21.3419	50.64	17.607	B
17		11	ISLAMPUR SHIRDI	191	17.3	390.6	3	1172	32881	28.0555	56.74	23.1458	B
18		12	SHIRDI ISLAMPUR	192	19.2	431.7	4	1727	32216	18.6543	37.66	15.3898	C
19		13	ISLAMPUR NASHIK	204	6.3	411.2	31	12747	355967	27.9256	65.73	23.0386	B
20		14	NASHIK ISLAMPUR	205	9	411.2	31	12747	317915	24.9404	58.7	20.5758	B
21									3852693	27.1513	61.705	22.3999	
22		Middle Distance services July - 2013 Islampur Depot											
23		Sr. N	Route	DU.NO.	Time	Dist.	Trips	K.M.	Earn.	EP/KM	L.F.	N. EP/KM	Gr
24		1	ISLAMPUR PUNE	32	6	188.8	31	5853	166339	28.4194	68.79	23.446	B
25		2	PUNE SANGLI	32	11.15	229.9	31	7127	245169	34.4	82.07	28.38	B
26		3	SANGLI PUNE	14	12.15	229.9	31	7127	213273	29.9247	71.39	24.6878	B
27		4	PUNE SANGLI	15	5	229.9	31	7127	174417	24.4727	58.38	20.19	B
28		5	SANGLI PUNE SWARGATE	38	13.15	229.9	31	7127	210860	29.5861	70.58	24.4085	B

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Sheet1

Sheet2

Sheet3

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Fig.1 Case Study Data Files Into Xls Format.

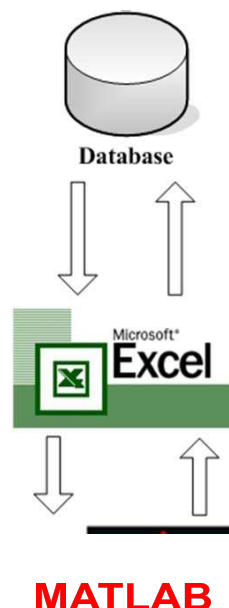
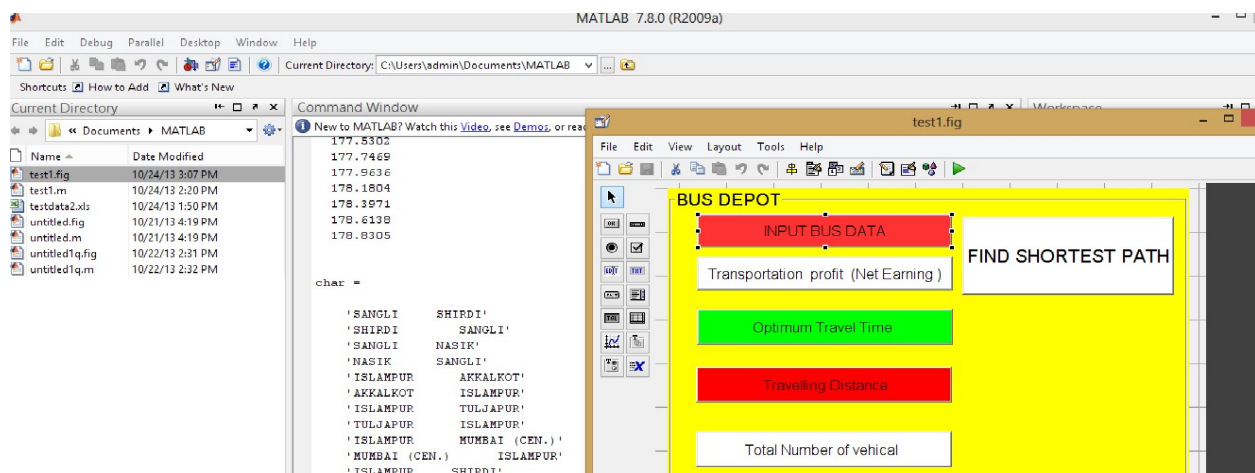


Fig.2 Implementation For Accessing The Database From Excel To Matlab [10]

Output Command Window in the Matlab :



B. Bus Network Flow Graph :

It should include all the services available from Source Node to Destination nodes. It can be Draw By Inspecting the available time table. it contains the all available services. Rectangular box indicates the Nodes and Directed line indicates the distance from Source to Destination. We have taken the example of Islampur bus depot in which there are total 812 number of services available. it should be required to implement the time table with using minimum number of bus count.

Here Matlab based Bus Network Flow Graph shown in fig.3 contains all the services from depot node to the various destination nodes.

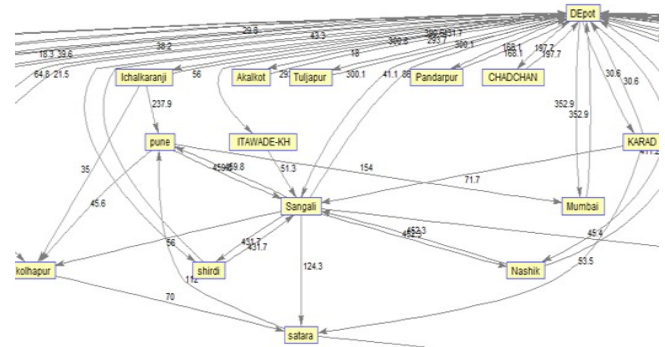


Fig.3 Bus Network Flow Graph Which Contains All Services.

C. Matlab GUI Window:

The figure.4 below shows the snapshot for a bus network consisting of several nodes in MATLAB. The Matlab GUI should contain the following Field:

- Input Bus Data
- Transportation Profit
- Optimum Travel Time
- Bus Network Flow Graph
- Find Shortest Path
- Display Shortest Distance

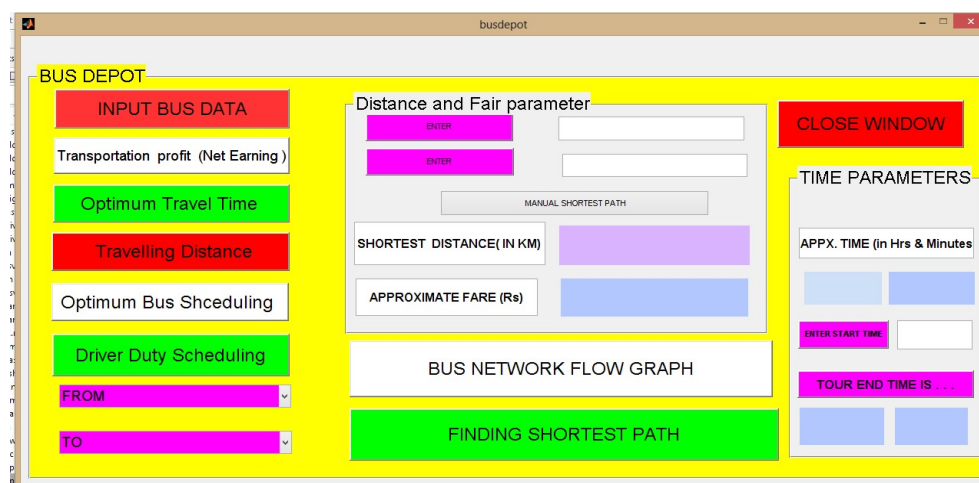


Fig. 4 MATLAB GUI Window For Finding Bus Network Flow Graph

D. Finding Shortest Path

Here we have to find the shortest path between two cities and path should be through available bus services. Let's find shortest path from depot (source node) to pune (destination node) from available bus network flow graph. We have two paths available. The shortest path from depot to pune is given by Red line in the bus network flow graph. There are other paths available from source to destination nodes but this algorithm finds the best path throughout the all possible paths. Bioinformatics Toolbox™ in matlab provides various routing commands for solving shortest path problem, vehicle routing problem.

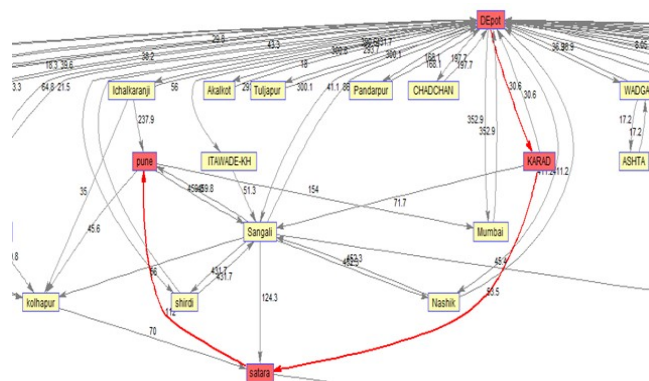


Fig. 5 Example of Finding shortest Path From DEPOT Node to PUNE Node in Bus Network Flow Graph.

Here in this example we are having Shortest Distance from Islampur to Pune is 210.2 K.M.

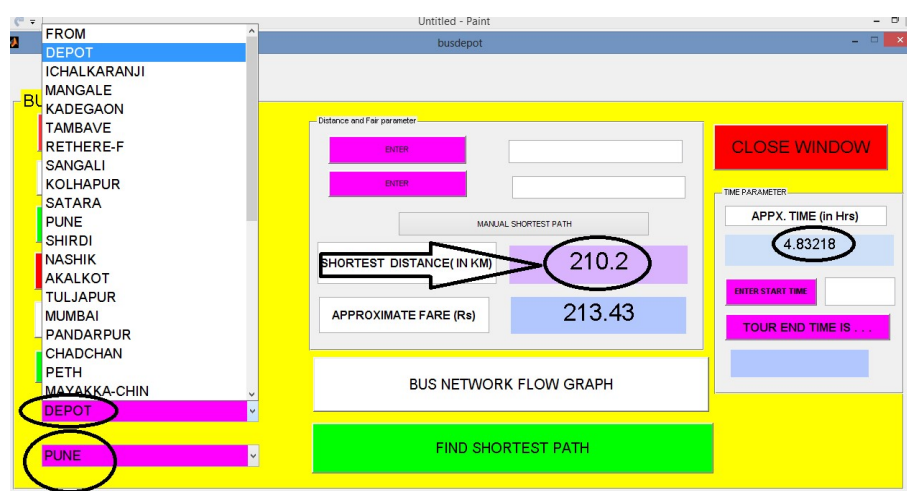


Fig. 6 Example of showing shortest Distance from Depot to Pune in MATLAB GUI Window.

E. Driver Duty and Bus Service Scheduling:

Here we have implemented driver duty scheduling algorithm in Matlab software where scheduling of up to 5000 drivers can be done. We have to enter the Number of Drivers we want to schedule and enter the start time and end time of each driver as shown in fig.6

Driver	Start Time	End Time
Driver1	1	5
Driver2	2	8
Driver3	4	6
Driver4	2	6
Driver5	5	12
Driver6	4	8
Driver7	1	7
Driver8	2	6
Driver9	2	3
Driver10	4	8

Fig. 6 Matlab GUI Window for Driver Duty Scheduling

The detailed schedule is displayed when all start time and end time of each driver is entered successfully. It contains the number of buses allocated to different Drivers as shown in fig.7

Bus	Hour1	Hour2	Hour3	Hour4	Hour5	Hour6	Hour7
Bus1	A	A	A	A	*	E	E
Bus2	G	G	G	G	G	G	0
Bus3	0	B	B	B	B	B	B
Bus4	0	D	D	D	D	0	0
Bus5	0	H	H	H	H	0	0
Bus6	0	I	I	C	C	0	0
Bus7	0	0	0	F	F	F	F
Bus8	0	0	0	J	J	J	J

Fig. 7 Bus Depot Driver Duty Schedule showing allocation of Different Drivers to Buses depending upon Hours.

IV . CONCLUSION

This work has successfully created a graphical user interface for Bus Depots. Since finding the optimization for this problem manually is very tedious task also it requires large computation time. It is possible to solve shortest path problem easily in matlab with Bioinformatics Toolbox™. The Matlab algorithm has proven itself to be a powerful tool for solving strong combinatorial optimization problems like the VRP.

One can consider the problems of routing and scheduling for buses with Multiple depots and problems with more complexity for further research. the implementation of this approach will help in developing feasible environment for public bus transportation.

V. RESULTS

The results were evaluated in terms of shortest route from depot's node to destination node based on different parameters like distance, cost associated with every service, time required. Also displayed the optimal route, optimal distance, approximate time. The Graphical user interface for bus depots has been developed. Driver duty scheduling and bus service scheduling have been done in Matlab software

REFERENCES

- [1]. Xiaoni Hao, Wenzhou Jin and Ming Wei “ Max-Min Ant System for Bus Transit Multi-depot Vehicle Scheduling Problem with Route Time Constraints” IEEE transactions on *Civil Engineering and Transportation*, July 2012
- [2]. Avishai (Avi) Ceder“ Optimal Multi-Vehicle Type Transit Timetabling and Vehicle Scheduling” *Procedia Social and Behavioural Sciences*, 20, 2011
- [3]. Spada, M.; Bierlaire, M. and Liebling, T. M. (2005). “Decision-aiding methodology for the school bus routing and scheduling problem”. *Transportation Science*, vol. 39, No. 4 (November), pp. 477-490.
- [4]. Braca, J.; Bramel, J.; Posner, B. and Simchi-Levi, D. (1997). “A computerized approach to the New York City school bus routing problem”. *IIE Transactions*, vol. 29, No. 8, pp. 693-702.
- [5]. Dai ying,Xia Wen-hui “Study of Multi Depot Problem Based on Milk-run Model” International Conference on Optoelectronics and Image Processing,2010
- [6]. Li, L. and Fu, Z. (2002). “The school bus routing problem: A case study”. *Journal of the Operational Research Society*, vol. 53, pp. 552-558.
- [7]. Park, J. and Kim, B.-I. (2010). “The school bus routing problem: A review”. *European Journal of Operational Research*, vol. 202, No. 2 (April), pp. 311-319.
- [8]. Dr. Abebe Geletu “Solving Optimization Problems using the Matlab Optimization Toolbox - a Tutorial”.
- [9]. Karlaftis, M.G., Vlahogianni, E.I., “Statistical Methods Versus Neural Networks in Transportation Research: Differences, Similarities and Some Insights” Department of Transportation Planning and

Engineering, School of Civil Engineering, National Technical University of Athens, Greece. 2011

- [10].Fangxing Lv1, 3, Yang Xu2, 3 “Study of the Solution to SCILAB Accessing Database”National High Technology Research and Development Program (863 Project) May 20, 2008.