(IJIEEE) 2015, Vol. No. 1, Jan-Dec **e-ISSN: 2454-9592; p-ISSN: 2454-8081**

OPTIMAL VEHICLE TIMETABLING, ROUTING AND DRIVER DUTY SCHEDULING CASE STUDY: BUS–DEPOT PROBLEM

Mr Tushar T. Rasal
Department of Electronics & Telecommunication Engineering
Rajarambapu Institute of Technology
Rajaramnagar, Islampur, Maharashtra, India.

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.

Keywords: *Bus Network Flow Graph, Shortest path problem, Network-Model, Vehicle routing problem (VRP), MATLAB.*

INTRODUCTION

The Buses and trains form the backbone of long distance travel in India. Now we are moving towards a transit friendly transportation system it is felt that, in the years to come Buses and Train travel will become more popular. In any Real-World Bus Network there are stations with multiple platforms (where boarding and alighting of passenger's takes place) for an efficient transit Bus transport system. It is imperative that to having the optimal planning of public transportation services. It is one of the most important goals of the urban administrations for its both economic and environmental effects. Along with the size of the city, even the impact of a slight relative reduction in the costs of some key activities might lead to considerable budget savings. One of such important cost factors is obviously the fuel consumption of the vehicles, comprising the major part of the energy requirements of the whole transportation system.

The primary factor of a bus company is allocating its limited public transportation resources to meet the passenger's trip demands efficiently. Creating a timetable plays an important role in regional bus scheduling, as it can minimize the transfer time of the passengers in every connection stop meanwhile, synchronized departure can deal with the problem effectively The aims of this

scheduling method are: (i) to make best use of the human, material and financial resources; (ii) to improve the active vehicle efficiency; (iii) to optimize route, operational cost.

Therefore, the research on timetable, which can meet the passenger's trip demands to the utmost, has been considered to be one of the important issues by many public transport experts all over 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 with several hundred, or over a thousand, Buses per day are common throughout Maharashtra and elsewhere. Such Bus stations typically have multiple number of intersecting Routes, connected to multiple parallel or sequential stopping points (platforms),The Buses differ in their types, speeds, desired departure times and arrival times, origins and destinations.

LITERATURE ON RELATED WORKS

Presently there are several methods to solve the vehicle routing problem. Jing-Quan Li[6] introduces several methods used to solve the vehicle routing problem. The Bus Depot Platform allocation and routing problem is a version of the travelling salesman problem (TSP) commonly referred to vehicle routing problems (VRP), either with or without time window constraints.

Park and Kim (2010) [6] presents, the general SBRP seeks to plan an efficient schedule for a fleet of buses where each bus picks up students from various bus stops and then delivers them to the school. Various constraints must be satisfied: maximum capacity of buses, maximum riding time of a student in a bus, and delivery time or time window to the school. In the literature, transportation problems involving transportation of students to schools have already been studied.

More recent works on school bus routing are due to Li and Fu (2002)[5], Spada, Bierlaire and Liebling (2005)[3], among others. The reader is referred to the work of Park and Kim (2010)[7] which is an updated state- of- the- art survey on different approaches to solve the school bus routing and scheduling problem.There are a lot of methods for analyzing the transportation issues; otherwise there are two main methods which are efficient: statistical methods and neural network methods. Vlahogianni has presented a comparison between these 2 methods and the advantages and disadvantages of these methods in analyzing transportation data [8]

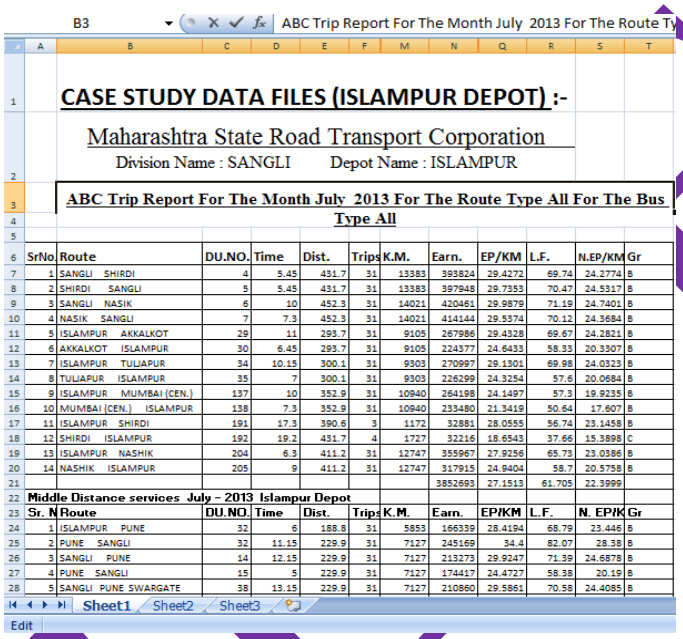
PROPOSED WORK

Through analyzing different methodologies, this project will provide guidelines for bus planning operators to develop an efficient and cost-effective Public bus Transportation route and schedule When number of entries become too large then it is become difficult to finding the optimization for such a larger entries manually it too much time consuming. It is efficient methods to solve this using MATLAB software.

A. Reading .Xls Sheet into Matlab Software.

Study of the Solution to Matlab Accessing Database there is two methods to solve the current difficult problem of accessing database in the Matlab technology are

- Uses Excel as the intermediary to achieve.
- Uses the features of the interface of Matlab with C computer language which can access database



CASE STUDY DATA FILES (ISLAMPUR DEPOT) :-

Maharashtra State Road Transport Corporation

Division Name : SANGLI Depot Name : ISLAMPUR

ABC Trip Report For The Month July 2013 For The Route Type All For The Bus Type All

SrNo.	Route	DU.NO.	Time	Dist.	Trips	K.M.	Earn.	EP/KM	L.F.	N.EP/KM	Gr
1	SANGLI SHIRDI	4	5.45	431.7	31	13383	393824	29.4272	69.74	24.2774	B
2	SHIRDI SANGLI	5	5.45	431.7	31	13383	397948	29.7353	70.47	24.5317	B
3	SANGLI NASIK	6	10	452.3	31	14021	420461	29.9879	71.19	24.7401	B
4	NASIK SANGLI	7	7.3	452.3	31	14021	414144	29.5374	70.12	24.3684	B
5	ISLAMPUR AKKALKOT	29	11	293.7	31	9105	267986	29.4328	69.67	24.2821	B
6	AKKALKOT ISLAMPUR	30	6.45	293.7	31	9105	224377	24.6433	58.33	20.3307	B
7	ISLAMPUR TULJAPUR	34	10.15	300.1	31	9303	270997	29.1301	69.98	24.0323	B
8	TULJAPUR ISLAMPUR	35	7	300.1	31	9303	226299	24.3254	57.6	20.0684	B
9	ISLAMPUR MUMBAI (CEN.)	137	10	352.9	31	10940	264198	24.1497	57.3	19.9235	B
10	MUMBAI (CEN.) ISLAMPUR	138	7.3	352.9	31	10940	233480	21.3419	50.64	17.607	B
11	ISLAMPUR SHIRDI	191	17.3	390.6	3	1172	32881	28.0555	56.74	23.1458	B
12	SHIRDI ISLAMPUR	192	19.2	431.7	4	1727	32216	18.6543	37.66	15.3898	C
13	ISLAMPUR NASHIK	204	6.3	411.2	31	12747	355967	27.9256	65.75	23.0386	B
14	NASHIK ISLAMPUR	205	9	411.2	31	12747	317915	24.9404	58.7	20.5758	B
							3852693	27.1513	61.705	22.3999	

Middle Distance services July – 2013 Islampur Depot

Sr. N	Route	DU.NO.	Time	Dist.	Trips	K.M.	Earn.	EP/KM	L.F.	N. EP/K	Gr
1	ISLAMPUR PUNE	32	6	188.8	31	5853	166339	28.4194	68.79	23.446	B
2	PUNE SANGLI	32	11.15	229.9	31	7127	245169	34.4	82.07	28.38	B
3	SANGLI PUNE	14	12.15	229.9	31	7127	213273	29.9247	71.39	24.6878	B
4	PUNE SANGLI	15	5	229.9	31	7127	174417	24.4727	58.38	20.19	B
5	SANGLI PUNE SWARGATE	38	13.15	229.9	31	7127	210860	29.5861	70.58	24.4085	B

Figure.1 Case Study Data Files Into Xls Format.

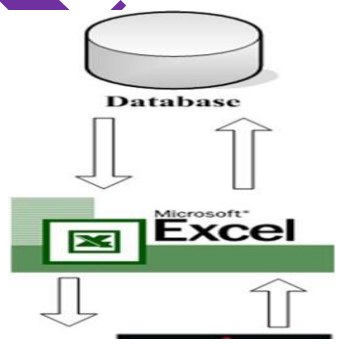


Figure.2 The Principle of Matlab Using Excel to Solve the Problem of Accessing the Database [10]

(IJIEEE) 2015, Vol. No. 1, Jan-Dec **e-ISSN: 2454-9592; p-ISSN: 2454-8081**

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.

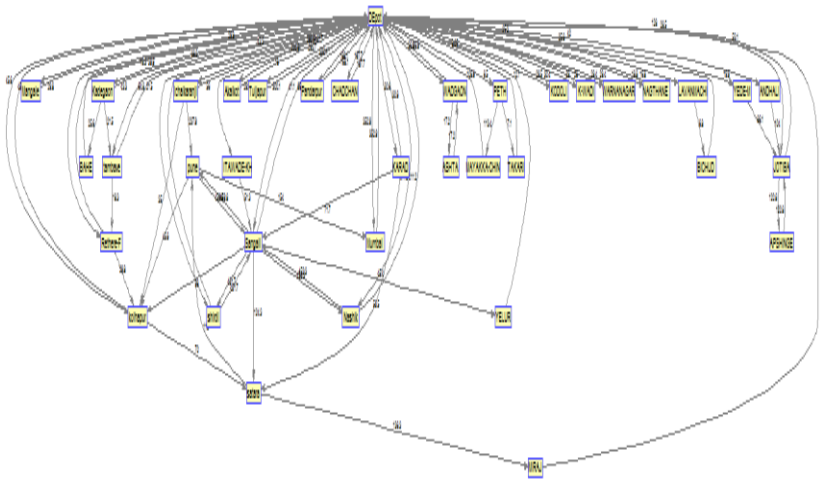


Figure 3. Bus Network Flow Graph Which Contains All Services.

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

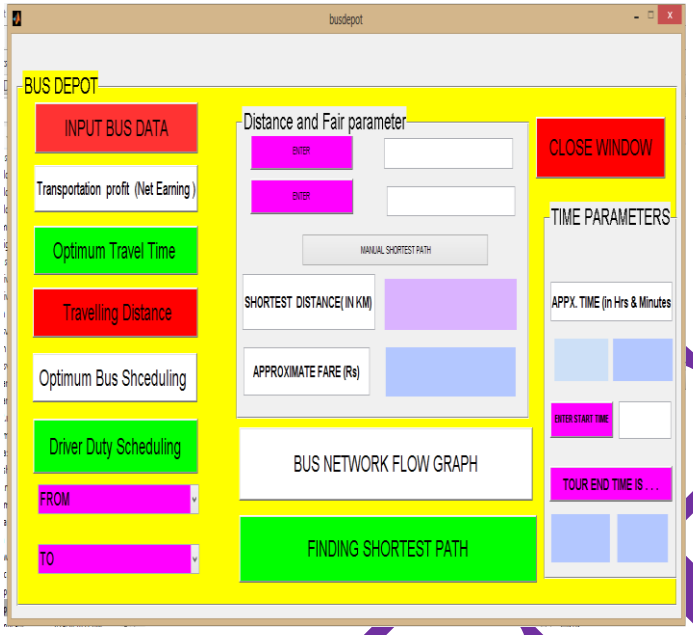


Figure. 4 MATLAB GUI Window for Finding Bus Network Flow Graph

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 between 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 are available from source to destination nodes but this algorithm finds the best path throughout the all possible paths. Bioinformatics Toolbox™ in Matlab provides various commands for solving shortest path problem, vehicle routing problem.

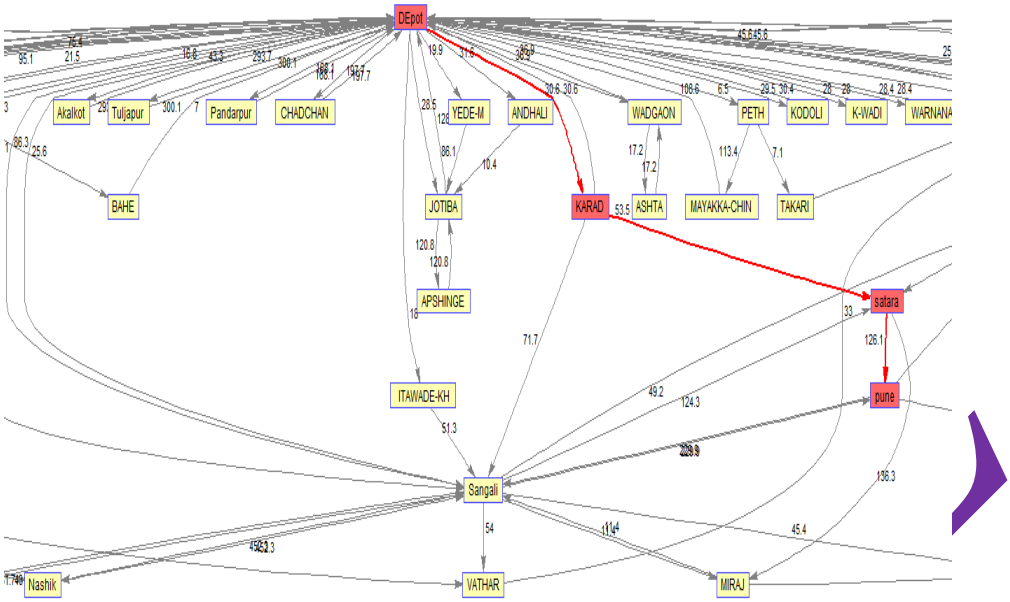


Figure. 5 Example of Finding shortest Path From Depot Node to Pune Node in Bus Network Flow Graph.

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

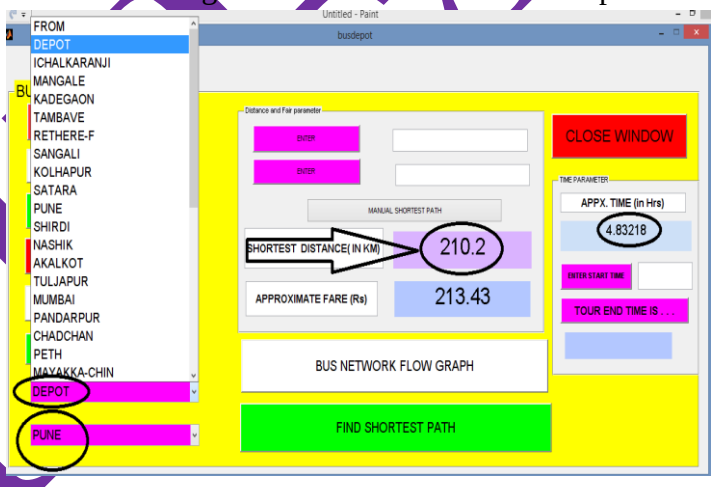


Figure. 6 Example of showing shortest Distance from Depot to Pune in MATLAB GUI Window.

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

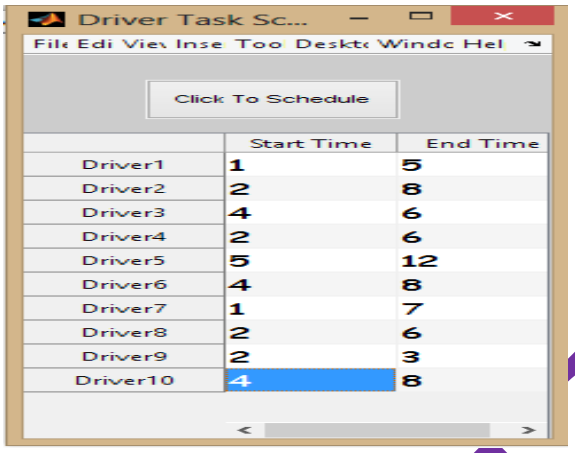


Figure. 6 Matlab GUI Window for Driver Duty Scheduling

The detailed schedule is displayed when all start time and end time of each driver is entered successfully.

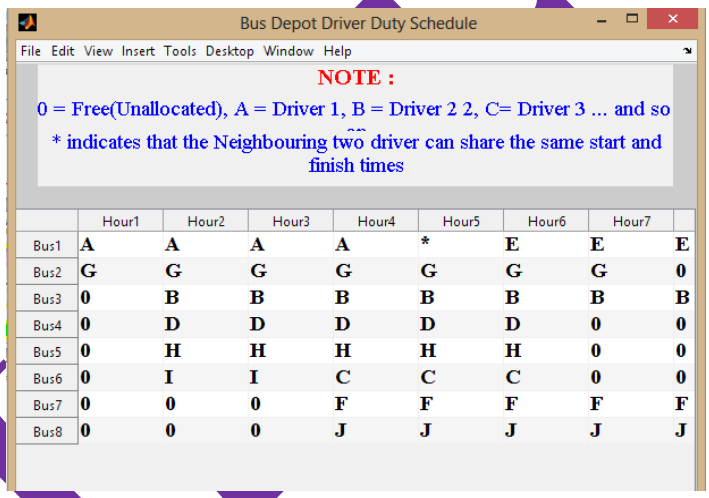


Figure. 7 Bus Depot Driver Duty Schedule showing allocation of Different Drivers to Buses depending upon Hours.

CONCLUSION

This work has successfully created a graphical user interface for Bus Depots. When number of entries become too large then it is become difficult to finding the optimization for such a larger entries manually it too much time consuming. .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. Extension of this approach not only to other type of routing problems including the multiple traveling salesman problem, vehicle routing problem and school bus routing problem but also to more complex cases like assignment and scheduling problems are promising subjects for further research. Also, the work contributes sufficiently towards creating a user friendly environment for bus transportation.

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] 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.

[2] Avishai Ceder "Optimal multi-vehicle type transit timetabling and vehicle scheduling " Procedia Social and Behavioural Sciences, 20 ,2011

[3] Spada, M, Bierlaire, M. and Liebling (2005). " Decision-aiding methodology for the school bus routing and scheduling problem ". Transportation Science, vol. 39, No. 4 (November), pp. 477-490.

[4] Dai Ying,Xia Wen-Hui " Study of multi depot problem based on milk-run model " International Conference on Optoelectronics and Image Processing,2010

[5] 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.

[6] Park, J. and Kim (2010). " The school bus routing problem: a review " European Journal of Operational Research, vol. 202, No. 2 (April), pp. 311-319.

[7] Dr. Abebe Geletu "Solving optimization problems using the matlab optimization toolbox - a tutorial" December 13, 2007

[8] 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

[9] Fangxing Lv,Yang Xu2 ''Study of the solution to scilab accessing database''National High Technology Research and Development Program (863 Project) May 20, 2008.

[10] Fügenschuh, A. (2009) "Solving a school bus scheduling problem with integer programming" European Journal of Operational Research, vol. 193, No.3 (March), pp. 867-884.