NOU J. Sc. & Tech. Vol. 3 & 4 (1) : 34-40, 2015

The shortest route of wild life sanctuaries in Odisha: A study

R. R. Jena[1], [2]K. Moharana, [1]S. Senapati, S. K. Mohanta*

[1] P.G. Department of Mathematics, [2] Dept of Mathematics,
North Orissa University, Baripada-757003
Corresponding author: Email: smohanta129@gmail.com

Abstract

The main purpose of this research article is to study shortest route between the wild-life sanctuaries in Odisha. First, we study a transportation model using graph theory and transform into network model of the transportation model based on wild-life sanctuaries. Secondly, we study the solution of network model that connects all the wild-life sanctuaries through the shortest route from single source to single destination.

Keywords: Transportation problem, shortest path, connected network, Dijkstra's algorithm.

Introduction

Graph theory is the study of points called nodes or vertices that are joined by lines called the edges or arcs. This research article is mainly focus to study shortest route between the wild-life sanctuaries in Odisha through a transportation model using graph theory and then transform into network model of the transportation model based on wild-life sanctuaries. The main work is to study the solution of network model by Dijkstra's Algorithm [4] that connects all the wild-life sanctuaries through the shortest route from single source to single destination. For this purpose we recall some known definition and results according to our requirement.

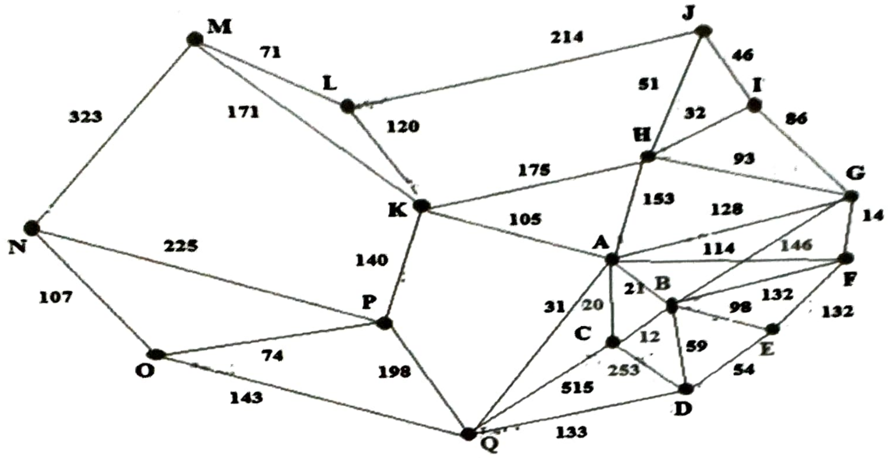
Graph: [6]
The collection of non-empty set of points or vertices or nodes and lines or edges is called the Graph denoted by G (V, E), where V is the set of all vertices(nodes) and E is the set of all edges(branches).

Network: [6] A network consists of a set of nodes linked by edges. Generally, a network model denoted as V = {A, B, C, … …} and E = {(A, B), (B, C), (A, C), (C, D), … …}, where V is the set of the vertices(nodes) represents sanctuaries and E is the collection of all edges between them.

Connected network: [6]
A connected network is such that every two distinct nodes are linked by at least one path.

Network model of the wildlife sanctuaries:
To form a network model of the wildlife sanctuaries in Odisha, we collect the information regarding location of wildlife

sanctuaries in Odisha such as distance (in Km), adjacent sanctuaries and all possible connected paths (by roads) through the Google map [1], [2] and [3]. The following network model has been developing without disturbing their geographical location [2].



Here in above transportation model A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q and R represents the sanctuaries *Nandankanan, Chandaka, Baisipali, Chilika, Balukhand, Bhitarkanika, Gahiramatha, Hadgarh, Kuldiha, Similipal, Satakoshia, Badrama, Debrigarh, Sunabedha, Karlapat, Kotagarh and Lakhari* respectively. The edges in the above model contain the road distances between the sanctuaries in kilometre. Now we are listing all the distances in tabulated form in increasing order of distances as below.

Serial No.	Edges	Lengths(Km.)
01	(C,B)	12
02	(F,G)	14
03	(A,C)	20
04	(A,B)	21
05	(A,Q)	31
06	(I,H)	32
07	(I,J)	46
08	(H,J)	51

09	(E,D)	54
10	(B,D)	59
11	(L,M)	71
12	(P,O)	74
13	(G,I)	86
14	(G,H)	93
15	(B,E)	98
16	(K,A)	105
17	(O,N)	107
18	(K,L)	120
19	(A,G)	128
20	(B,F)	132
21	(F,E)	132
22	(Q,D)	133
23	(P,K)	140
24	(O,Q)	143
25	(B,G)	146
26	(A,H)	153
27	(K,M)	171
28	(K,H)	175
29	(P,Q)	198
30	(L,J)	214
31	(N,P)	225
32	(D,C)	253
33	(M,N)	323
34	(Q,C)	515

The shortest path algorithm: [4] & [5]

The shortest path algorithm is a small group of efficient algorithm. In a network model any node or vertex may be connected by edges to any number of other nodes. Here every edge represented by weight distance. Finding the shortest route may help to travel these sanctuaries with less time and money. The study based on the shortest route of single source to single destination in network model.

Dijkstra's algorithm: [7]

In this article Dijkstra's algorithm is used to solve the single source single destination shortest path problem in a graph theory for both directed and undirected graphs. All edges must have non-negative weights graph must be a connected graph. According to the hypothesis: Dijkstra's algorithm has optimal substructure property. i. e., A least cost path from "X" to "Y" contains least cost paths from "X" to every city on the path to "Y". Example, if " X'!C_1 '!C_2'!C_3'!Y" is the least cost path from "X" to "Y" , then

"$X \to C_1 \to C_2 \to C_3$" is the least cost path from "X" to "C_3". "$X \to C_1 \to C_2$" is the least cost path from "X" to "C_2". "$X \to C_1$" is the least cost path from "X" to "C_1". To establish the result, we prove the hypothesis by method of contradiction.

Assume the hypothesis is false, i.e., Given a least cost path "P" from "X" to "Y" that goes through "C" , there is a better path "P_1" from "X" to "C" then the "P". But we could replace the sub path from "X" to "C" in "P" with this lesser cost path "P_1". The path cost from "C" to "Y" is the same. Thus we Now have a better path from "X" to "Y" . But this violets the assumption that "P" is the least cost path from "X" to "Y". Therefore original hypothesis must be true.

We describe the solution by these following steps.

Step 01:

We start from node B which is chosen as the permanent starting node.

Step 02:

Analysis the distance of the neighbouring nodes.

Step 03:

Continuing the process by choosing the smallest distance to other points and get the shortest path at last.

For example, to elaborate these steps consider the all possible paths from "A" to "M" and choosing the best shortest path between these two vertices "A" and "M". Here three possible paths are calculated in the following three options

First option:

Path $= A - H - I - J - L - M$

Shortest path

$= 153 + 32 + 46 + 214 + 71 \quad = 516$

Second option:

Path $= A - H - J - L - M$

$S = 153 + 51 + 214 + 71 \quad = 489$

Third option:

Path $= A - K - L - M$

$S = 105 + 120 + 71 \quad = 296$

Fourth option:

Path $= A - K - M$

$S = 105 + 171 = 276$

Therefore the fourth option represents the minimum cost from point A to M.

Shortest path finding stage:

We are using the following iteration procedure to solve our problem

Iteration 01:

Step I:

The distance matrix given below summarizes that the path exist between the starting vertex (B) to other vertices.

A	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
21	12	59	98	132	146	--	--	--	--	--	--	--	--	--	--

Step II:

Here 12 km. This is the shortest distance from B and the node is C.

Step III:

Hence the required destination is C.

Iteration 02:

For node C nodes A, Q and D are the neighbours having distances 20, 515, 253 km respectively so the updated distances taking C as the starting point is given below.

A	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
3	2	-	-	-	-	-	-	-	-	-	-	-	-	5
2	6	-	-	-	-	-	-	-	-	-	-	-	-	2
	5			-										7

Now here A having the smallest distance so A is the next destination.

Iteration 03:

Now A is the starting point again repeats the process we have neighbour points H, K and Q having distances 153km, 105km and 310km. Now updating the distances from point B in the following tabulation.

D	E	F	G	H	I	J	K	L	M	N	O	P	Q
-	-	-	-	1	-	-	1	-	-	-	-	-	3
-	-	-	-	3	-	-	3	-	-	-	-	-	4
			-	7			7						2

In this iteration K has least distance value. So the new destination is K with value 137 km.

Iteration 04:

Collect the neighbour nodes of K having smallest distance. Now L, M and P are the neighbouring of point K having distances 120km, 171km and 140kms. Now updating the values in the following table.

D	E	F	G	H	I	J	L	M	N	O	P	Q
-	-	-	-	-	-	-	2	3	-	-	2	-
-	-	-	-	-	-	-	5	0	-	-	7	-
			-				7	8			7	

Here L is nearest neighbour having distance 105 km. So L is now be the new destination and updated value is 257km.

Iteration 05:

Now M and J are the neighbouring nodes of L having distances 71km and 214 km, so the updated table is given below.

D	E	F	G	H	I	J	M	N	O	P	Q
-	-	-	-	-	-	4	3	-	-	-	-
-	-	-	-	-	-	7	2	-	-	-	-
			-			1	8			-	

Here M has the least value and it is the new destination and the updated value is 328km.

Iteration06:

we are choosing the neighbours of M, as going to K point form a closed loop so there is only one choice that is n having distance 323 km and the updated value is 651km.

Iteration 07:

Now neighbours of N that are P and O having distances 225km and 107 km. So the updated table is given below.

D	E	F	G	H	I	J	M	N	O	P	Q
-	-	-	-	-	-	-	-	-	7	8	-
-	-	-	-	-	-	-	-	-	5	7	-
			-						8	6	

Here point O is the new destination point having updated value 758km.

Iteration 08:

Here P and Q are neighbouring nodes of O 74km and143km. Now the updated table is given below.

D	E	F	G	H	I	J	M	N	P	Q
-	-	-	--	-	-	-	--	-	83	90
-	-	-	-	-	-	-		-	2	1

Here we get P as the next new destination and updated value is 832km.

Iteration 09:

Similarly K and Q are neighbouring of and K forms a closed loop. So Q is the single choice having value 198kms. The new updated value is 1030km.

Iteration 10:
Now A, C and D are neighbouring nodes of Q. Here D is the only choice because nodes A and C forms a closed loop. So D is new destination having distance 133 km and updated distance is 1163km.

Iteration 11:
Here D is the starting node having neighbours E and B. As going to B forms a loop so we have to choose E having distance 54 km and the updated value is 1217km.

Iteration 12:
Here B and F are the neighbours of E, but going to B forms a loop. So F is the new destination having value 132km and updated value 1349km.

Iteration 13:
Here neighbours are A and G of F, but going to A forms a loop. So G is the next newS destination having value 14 km and updated value 1336km.

Iteration 14:
Now for G the neighbours are A, H and I having value128km, 93km and 86km respectively as going to A forms a loop. So we have to ignore the point A. The updated table is given below.

H	I	J
1456	1449	--

As node (I) has least value. So our new destination. Now the updated path length is 1449km.

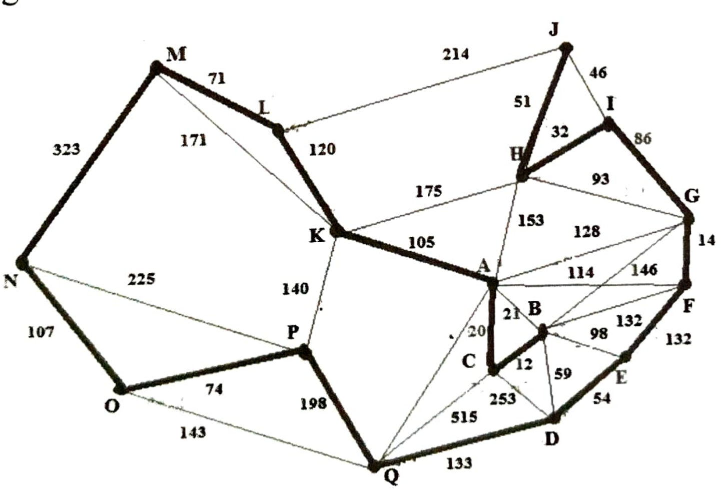
Iteration 15:
The neighbours of I are J and H having distances 46km and 32km. So the updated table is given below.

H	J
1481	1495

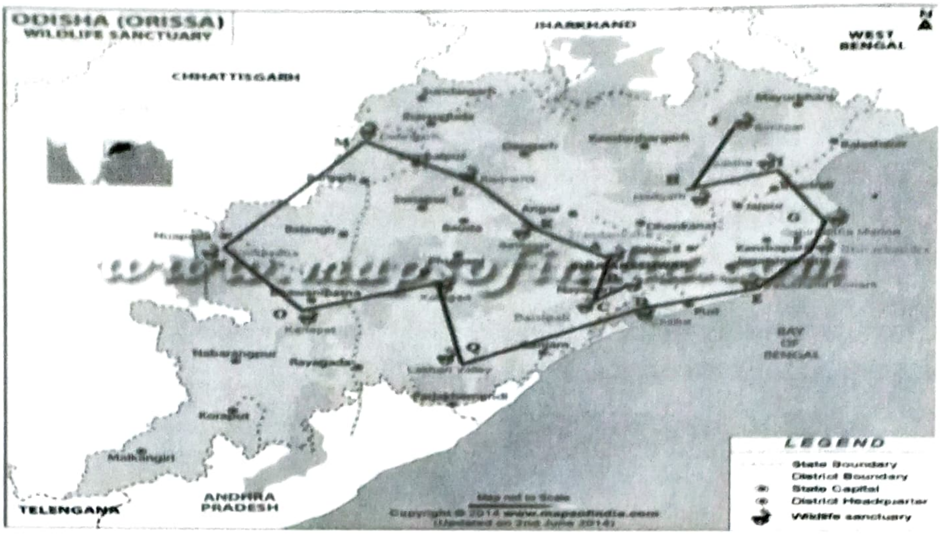
As H has least distance and it is our new destination. Now the updated value is 1481km.

Iteration 16:
Now H has four neighbours I, G, A, K and J. As I forms a loop with G, A and K, so we have to go to the point J for our final destination as we have already traced all other nodes .so now the updated value is 1532km.

Here we have got the shortest path that is B-C-A-K-L-M-N-O-P-Q-D-E-F-G-I-H-J darken in the network given below. And the shortest distance is 1532km. From *Chandaka* to *Similipal* wild life sanctuary.



The final shortest route has been presented in the Odisha as follows.



Conclusion

Dijkstra's Algorithm will find the shortest path between two points (single source to single destination). The above work for finding the shortest path using the Dijkstra's Algorithm is helpful for tourists to visit all the wild life sanctuaries in Odisha by expending less time and money from single source(Chandaka) to single destination(Similipal).

References

[1]. www.maps of india.com, copyright©2014.

[2].www.orissatourism.org,copyright©2008-2012.

[3]. Mapdata©2016google.

[4]. Chamero, juan (2006), Dijkstra's algorithm as a dynamic programmingstrategy. www.intag.org.

[5]. Rutter,sh(2009) Dijkstra's algorithm final project EDUC 528 from http://shawenrutter.com/pdf/dijkstra_algo.pdf.

[6]. Graph theory with applications to engineering and computer science by Narasingh Deo, PHL Learning Private Limited, Delhi-110092, 2013.

[7]. The shortest path problem, cpts 223, school of EECS, WSU. http://skylight.wsu.edu/s/053eadf6-6157-44ce92ad-cbc26bde3b53.srv.