Group of Possible Shorter Paths from Source to Destination

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ABSTRACT

This paper clips a reduced graph from a graph, and redefined it into levels. Then find the set of shorter paths from Source to Destination. Source node as root in the first level and destination node as leafs in different levels of the graph. This paper formulates an algorithm which provides other shorter paths from source to destination. The graph may represent network lines for transferring packets, pipeline for transfering liquid and transportation links. The proposed algorithm finds the shortest path and discovers other shorter paths from source to destination with lesser traffic. The selection of node is done using GIS because it is capable enough to express the connectivity of node with one another. The proposed algorithm is compared with Dijksra's Algorithm and the results are satisfactory. Simulated results are formulated using Matlab. The result assures the potential of the Algorithm.

Keywords

Geospatial Information System, Shortest Path Algorithm, Routing, Graph.

1. INTRODUCTION

The idea of this algorithm is implemented with the help of graph and levelling of graph. Dijkstra's Algorithm finds the paths by weight precedence. It solves the single source shortest path issue [1] when the weights are non negative values. It is a greedy algorithm and hence similar to Prim's algorithm. The algorithm starts at the source node and a tree grows which reaches to all the nodes describing the shortest path. [2][3][4]

Geographical Information System (GIS) [5] use geospatial analysis. It is a growing technology paradigm, which is a powerful tool to solve complex problem in special environment in tabular presentation. GIS provide geographic data of any location successfully with its altitude, height, location and connectivity and many more. [6][7][8]

2. PROPOSED ALGORITHM

Let us consider an arbitrary graph of n number of nodes (Cities / Connectors / Distribution points) from the real world co – ordinates (Figure 1) with the help of GIS, where n is equal to 21. We consider the real time data about the nodes location and connectivity between them. Geospatial Information System (GIS) will provide the location of the city and the distance (weight) between the nodes. If the nodes are cities then it will be on land, if the nodes are connector for internet wire or distribution point for liquid transportation, then it will be on land as well as very deep under water. This paper has taken a generalized selection of nodes which is under water and as well as on land. Connection and Distance between nodes of Real World Geospatial Space is shown in Figure 1.

Let Graph G = {V, E} where V = {A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, V} and E = {{A,B}, {A,C}, {B,E}, {B,D}, {C,D}, {C,F}, {C,G}, {D,E}, {D,F}, {E,I}, {E,H}, {F,H}, {F,G}, {G,H}, {G,K}, {G,Q}, {H,I}, {H,J}, {H,K}, {I,O}, {I,V}, {I,J}, {J,V}, {J,L}, {J,K}, {K,L}, {K,M}, {L,N}, {L,M}, {V,N}, {M,P}, {M,Q}, {N,O}, {N,R}, {N,P}, {O,R}, {O,P}, {P,R}, {P,T}, {P,S}, {P,Q}, {Q,S}, {R,T}, {S,T}}

If the count of the nodes decreased then the execution time will also decrease. And the search space is also reducing for the shortest and shorter paths. Procedure to create the Reduced Graph - Select those nodes of whose x-values lies between the x-values of the source and destination and whose magnitude is less than the magnitude of the source and the destination nodes, shown in Figure 2 followed by Algorithm to create Sub - Graph from Main - Graph.

2.1 Algorithm

Creation of Sub – Graph from the Main – Graph

Step 1: Choose Source Node. [TSource = Source; TSource stands for Temporary Source]
Step 2: Create First Level.
Step 3: Place TSource in the Level.
Step 4: Find connecting nodes to TSource and Add it to Queue.
Step 5: If all Nodes of the Same Level not Traversed.
    TSource = un – Traversed node in the same Level.
    Goto Step 6.
  else
    Goto Step 3
Step 6: Create the next Level (Level++)

Step 7: Add the Queue to the Level.

Step 8: If Destination Found && Every Nodes is Traversed in the same Level
    Goto Step 9
  else
    TSource = Next un – Traversed node in the Same level.
    Goto Step 4
Step 9: End.

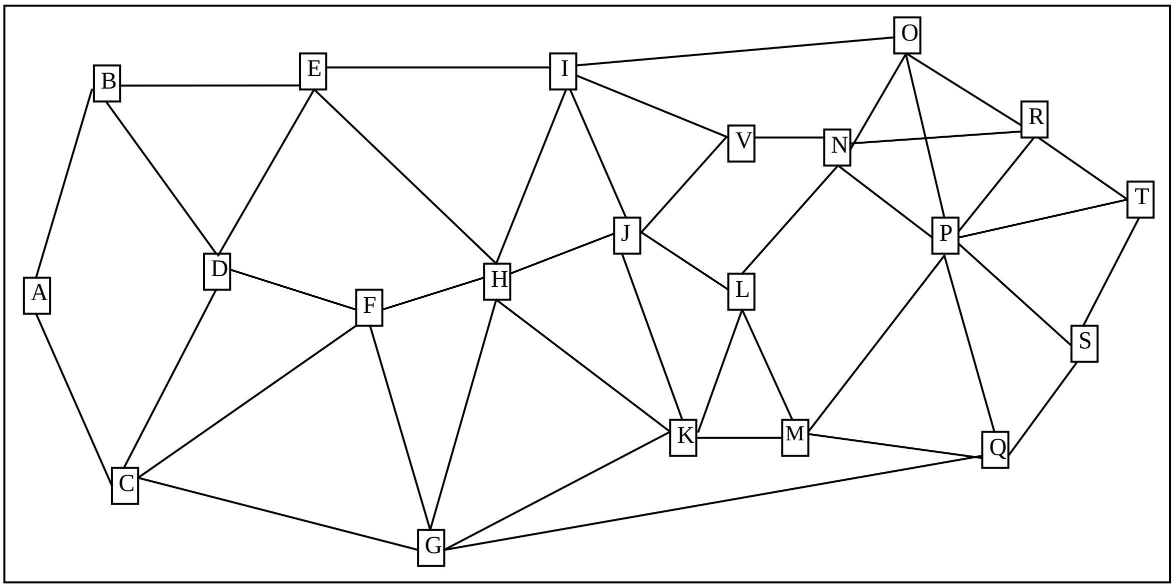

Figure 1: Connection and Distance between Nodes found in Real Geospatial Space (Main Graph).

Table 1: Information of Length of Edges of Figure 1.

Edge	Length	Edge	Length	Edge	Length
A-B	36.359	G-Q	129.03	M-Q	47.802
A-C	34.986	H-I	28.231	N-O	22.627
B-D	38.013	H-J	28.862	N-P	27.203
B-E	54	H-K	41.231	N-R	51.01
C-D	33.601	I-J	25.495	N-V	22
C-F	57.871	IO	83.217	O-P	32.558
C-G	76.531	I-V	46.098	O-R	38.91
D-E	31.828	J-K	25.08	P-Q	31.78
D-F	36.139	J-L	27.659	P-R	32.65
E-H	55.471	J-V	29.411	P-S	47.127
E-I	60	K-L	24.042	P-T	65.376
F-G	34.205	K-M	29	Q-S	35.341
F-H	37.336	L-M	20.809	R-T	36.878
G-H	35.777	L-N	27.459	S-T	35.341
G-K	56.321	M-P	36.674		

The weights of the graph shown in Figure 1 has been represented in Table 1.

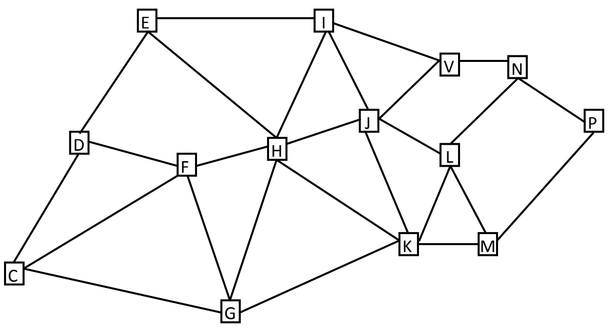

Figure 2: Reduced Graph

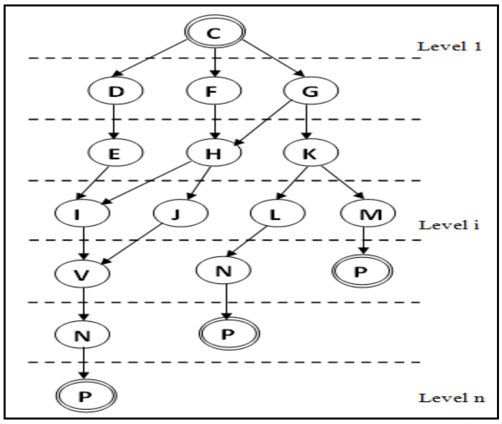

Figure 3: Formation of Leveled Graph.

Table 2: Representation of Possible Paths

Path No.	Path	Value
1	C-D-E-I-V-N-P	222.73
2	C-F-H-I-V-N-P	220.739
3	C-F-H-J-V-N-P	202.683
4	C-G-H-I-V-N-P	273.84
5	C-G-H-J-V-N-P	219.784
6	C-G-K-L-N-P	211.556
7	C-G-K-M-P	198.526

The algorithm that is discussed above (Figure 4 Flow Chart of same), TSource is considered as Temporary Source. Firstly our source from where we need to travel is selected and then the destination to where we need to reach is considered. Now creating a level is important. Then we place the source in the level and these nodes in the next level will be connected to the source node. Now we will move down to the next level and will do the same with every node in the level. The process will continue until the destination is reached. [8][9][10]

The essence of the work is that it reduces the graph into levels (Figure 3 Levelled Graph) and the first level contains the source vertex and the last level (or leaf nodes) will contain destination vertex. As "Algorithm for creation of Sub – Graph from Main Graph" gives birth to levelled Graph whose end leafs are destination node. Any traverse from first level (Source Node) to any of the leaf will be a path form source to destination, shown in Table 2.

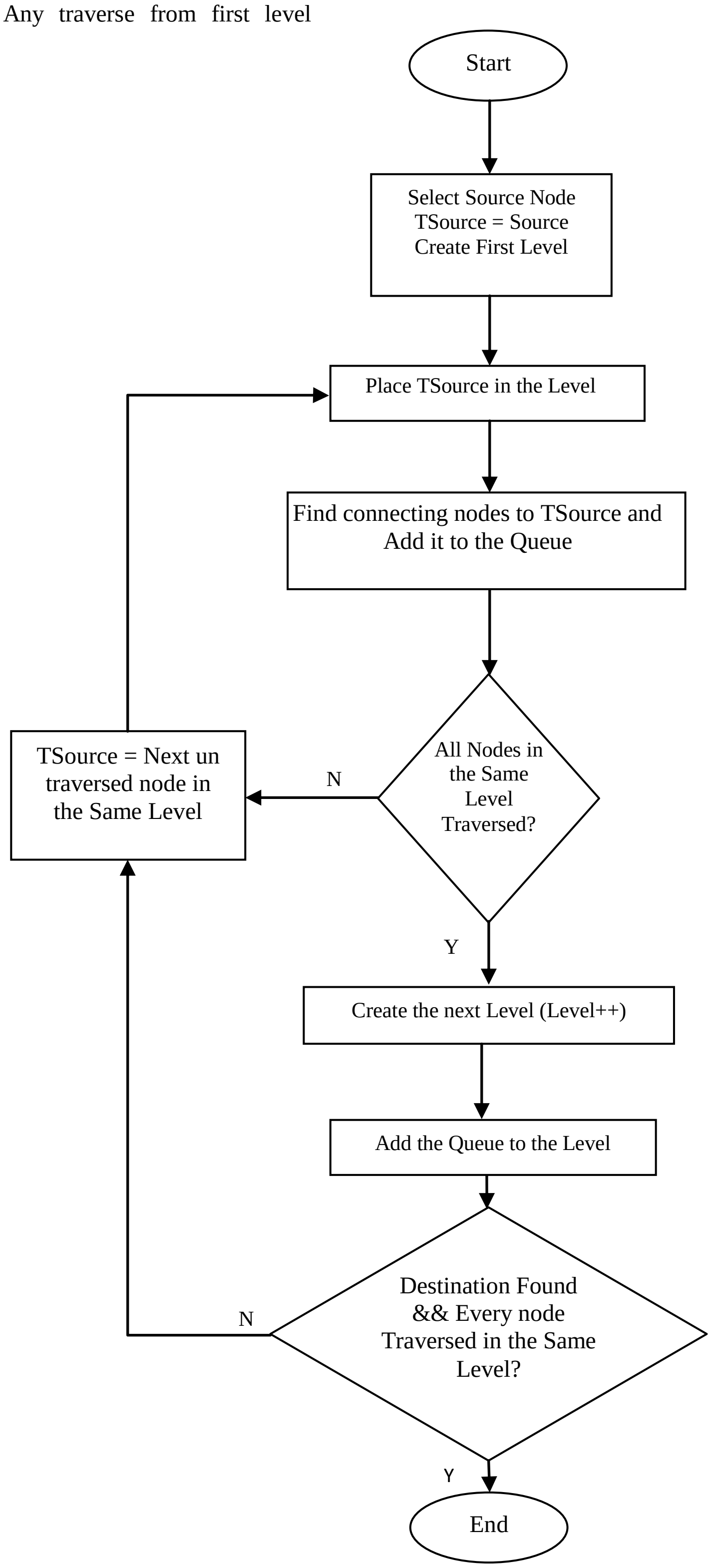

Figure 4: Flow Chart Representation of Creation of Sub-Graph from Main-Graph Algorithm

Table 3: Comparison of the Proposed Algorithm with Dijkstra's Algorithm

<table>
<tr><th colspan="4">Proposed Algorithm</th><th colspan="2">Dijksra'a Algorithm</th></tr>
<tr><th>Path No.</th><th>Path</th><th>Value</th><th>Discussion</th><th>Path</th><th>Value</th></tr>
<tr><td>1</td><td>C-D-E-I-V-N-P</td><td>222.73</td><td rowspan="7">These are the possible feasible shorter paths from Source C to Destination P other than dijkstra's shortest path (Path 7)</td><td>C-G-K-M-P</td><td>198.526</td></tr>
<tr><td>2</td><td>C-F-H-I-V-N-P</td><td>220.739</td><td colspan="2" rowspan="6">Dijkstra's Algorithm only find the possible shortest path but do not find any other possible shorter path form source to destination so that it can be used in difficult or crisis situation.</td></tr>
<tr><td>3</td><td>C-F-H-J-V-N-P</td><td>202.683</td></tr>
<tr><td>4</td><td>C-G-H-I-V-N-P</td><td>273.84</td></tr>
<tr><td>5</td><td>C-G-H-J-V-N-P</td><td>219.784</td></tr>
<tr><td>6</td><td>C-G-K-L-N-P</td><td>211.556</td></tr>
<tr><td>7</td><td>C-G-K-M-P</td><td>198.526</td></tr>
</table>

3. COMPARATIVE STUDIES

If we compare the above example with Dijkstra's Algorithm, six more possible paths are available to reach to destination. Proposed algorithm produce the shortest path with other shorter paths options where as Dijkstra's algorithm produces only the shortest path, shown in Table 3.

Finding the shortest route to reach P from C? According the Dijkstra's algorithm we get the shortest path evaluated in Table 2 is:

[C – G – K – M – P] --- 198.526

4. CONCLUSION AND FUTURE WORK

The proposed algorithm finds the shortest path from source to destination and also finds alternative paths. If there is congestion in the shortest path then it take more time, if we follow other path having less congestion then destination can be reached in much more less time, if the path is available and valid.

Run time decision is not dealt with the proposed algorithm, which can be called a mutation in the path. In my forthcoming work I will be dealing this problem.

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