Route Optimization Using Dijkstra's Method in Home Health Care Services

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Abstract

In this paper, a new approach is introduced for solving the route optimization problems and provide a solution for variant of this problem. The concept of proposed method is to use matlab software that uses an algorithm based on Dijkstra's method to find an optimal solution for a given problem. Presently the proposed approach is applied to a home health care system which deals with the providing medical care and emergency services to the patients. The method was explained with the help of an example and same can be implemented for the other applications also. The proposed method builds on the concept of Dijkstra's method which is very simple, easy to understand and apply.

Keywords: *Dijkstra's methods, home health care, route optimization.*

1. Introduction

Home Health Care services (HHC) are becoming a graduallysignificant problem in the last few years, covering a great variety of decisions in Operational Research context (Cheng and Rich, 1998). Advantages of these services concern old age and/or people expressing different needs (such as medicines, medical care, intensive care, etc.), by offering them the opportunity to live in their homes with an equivalent medical follow-up to that given in Hospital (Mondal et al., 2013). Research on this field includes a fine coordination of human and material resources to provide an optimized planning that maximizes the quality of home health care while controlling generated costs.

In this paper, we propose to simplify the traditional vehicle routing problem to tackle new particular characteristics related to home health care (Liu et al., 2013).The main goal is to optimized routes to be performed by an available vehicle (related to caregiver) and fit to visit a set of geographically distributed customers (related to the patients), who have preferences towards caregiver, and so that the activity is planned in the most effective way (Haddadene et al., 2016). The originality of this study relies on the fact that several care services may be required to visit a particular set of customers either to supply some delicate medicines or giving some sort of insulin or to collect samples etc. within the least possible time. Thus, the route between each node, firstly, should be optimized followed by the optimization of entirenodes.During the optimization it should be kept in mind that each node should be visited once and only once at a time and should return to its origin at the end.

In thehome health care services center their problem is occurs in that way when theirgeographical manner there demand of services is generated. And service center has to provide services to that area where demand is generated. Our main moto is to provide no. of services in sort time or as soon as possible. In our problem their special client who have emergency case their service must be provide first then proceeds further.

By shorting no. of service provider at minimum time we should have to short time first at only initial to next node after choosing these nodes we apply Dijkstra's method to choosing shortest path for only two nodes (Skiena, 1990). In these Dijkstra's method there initial and final node is fixed only path will be shorted by these methods and so on next node calculate their distance too next to next node or initial node then which path is shortest is chosen by the Dijkstra's method is fixed as path of theseroute. After solving their node shortest path their big question is arise that the service provider has to provide no. of services of no. of people at minimum time then how can he/she provide services in short time.

For solving these problemstheir onemore method is used Hungarian method these method is used to optimized no. of route and visited node by optimum path and short period of time so that the cost is proportionally decreases according to time of travelling. Most important point is here during visiting timeof providing services their time for waiting is fixed in each node. Means that the time taken to provide services at each node is fixed and in during service providing time if their one or extra demand is occurred by the customer that time these order be provided next time not that same time.in the visiting time their condition is that service provider provide service only once at a time.

DIJKSTRA'S METHOD

EdsgerWybeDijkstra 11 May 1930 – 6 August 2002 was a Dutch computer scientist and an early developer in many research areas of computing science. According to the Dijkstra'stheir vertices is define and edges is describingby following these techniques should find optimum vertices followed by choosing best solution for reaching initial node to end node

A method similar to Prim's algorithm is Dijkstra's method used as the optimization technique. In this, we generate a path for shortest route from the given source node already defined. Two sets should be maintained, one contains vertices comprised of shortest path, and other includes vertices not yet considered in shortest path. At each step of the algorithm, a vertex is to be found which is in the other set and has least distance from source. Assume the path is started is initial node and last visited node is final node.

DIJKSTRA'S ALGORITHM APPLIED TO PRESENT STUDY

Dijkstra's Algorithm assigns to every node j a pair of labels (pj, dj), where pj is the node preceding node j in the existing shortest path from 1 to j, dj is the length of this shortest path. Some of the labels are called temporary, i.e. they could change at a future step; some labels are called permanent, i.e. they are fixed and the shortest path from 1 to a node that is permanently labeled has been found.

We denote by d_{jk} the length of arc (j,k).

Step 1. Label node 1 with the permanent labels ($\varnothing$,0). Label every node j, such that (1,j) is an arc in the graph, with temporary labels (1, d_{1j}). Label all other nodes in the graph with temporary labels ($\varnothing$, ∞).

Step 2. Let j be a temporarily labeled node with the minimum label dj, i.e.

d_j = min{dl: node l is temporarily labeled}.

For every node k, such that (j,k) is in the graph, if $d_k > d_j + d_{jk}$ then relabel k as follows:

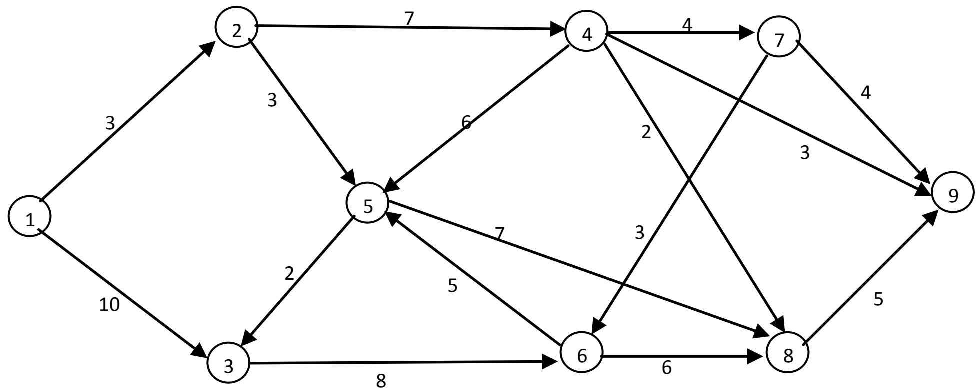
$p_k = j$, $d_k = d_j + d_{jk}$.

Consider the labels of node j to be permanent.

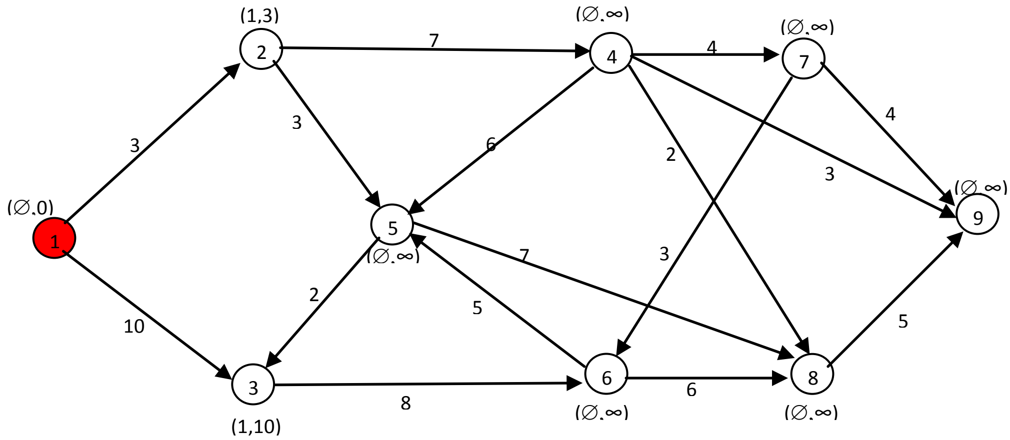
Step 3. Repeat step 2 until all nodes in the graph are permanently labeled.

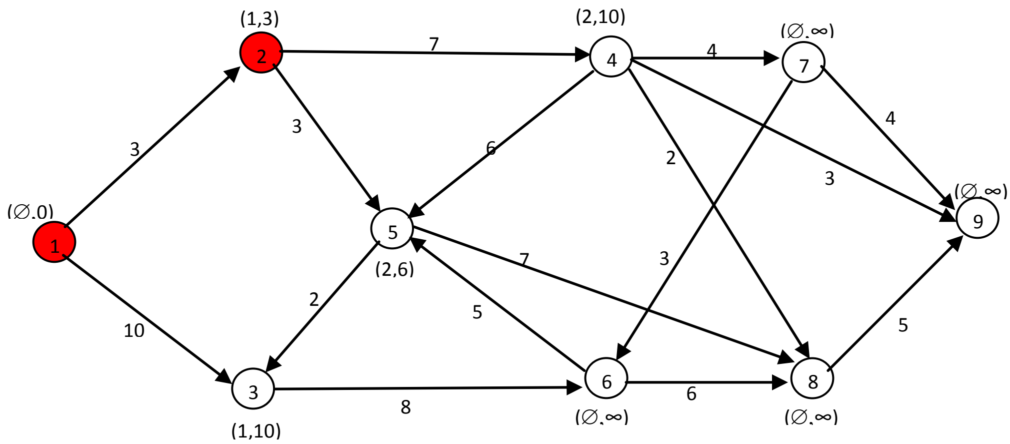
The shortest paths can be found by reading labels p_j.

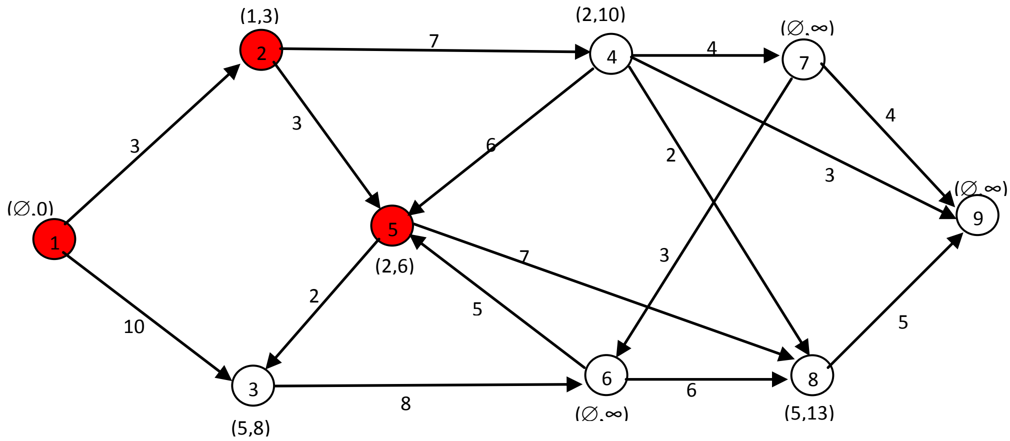
Example. Find the shortest paths from node 1 to all other nodes.



We color the nodes with permanent labels red.



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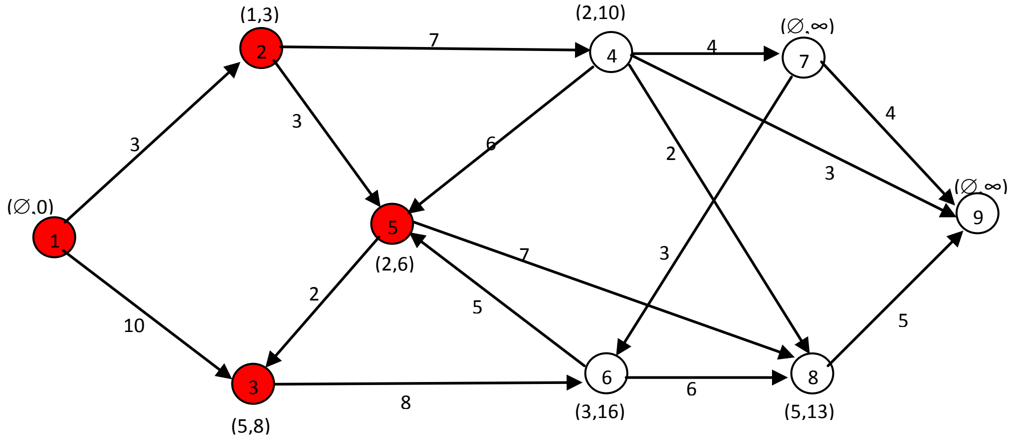
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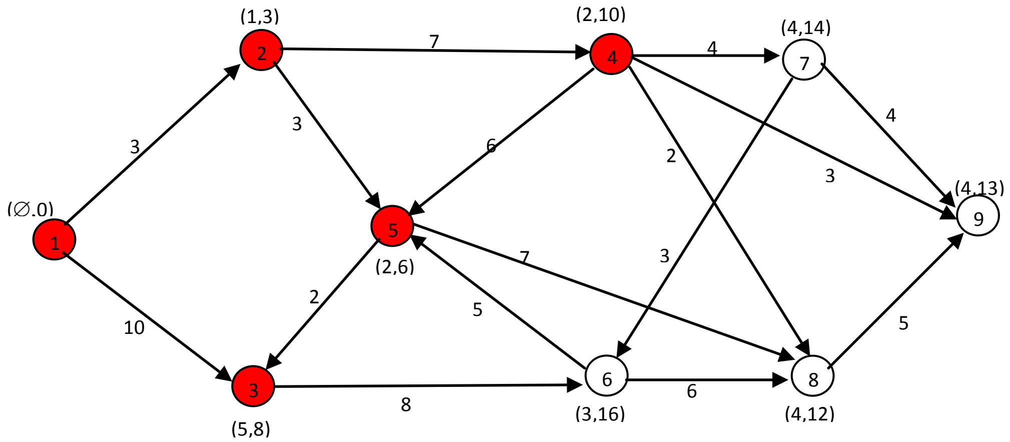
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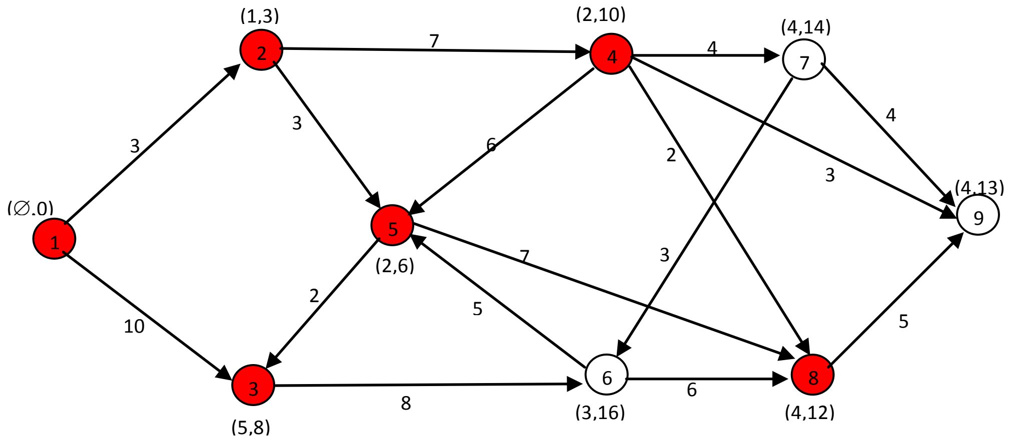
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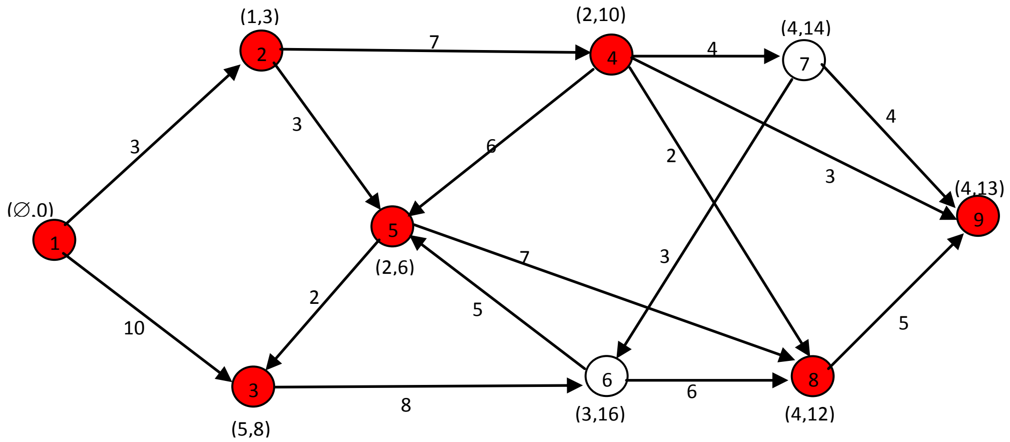
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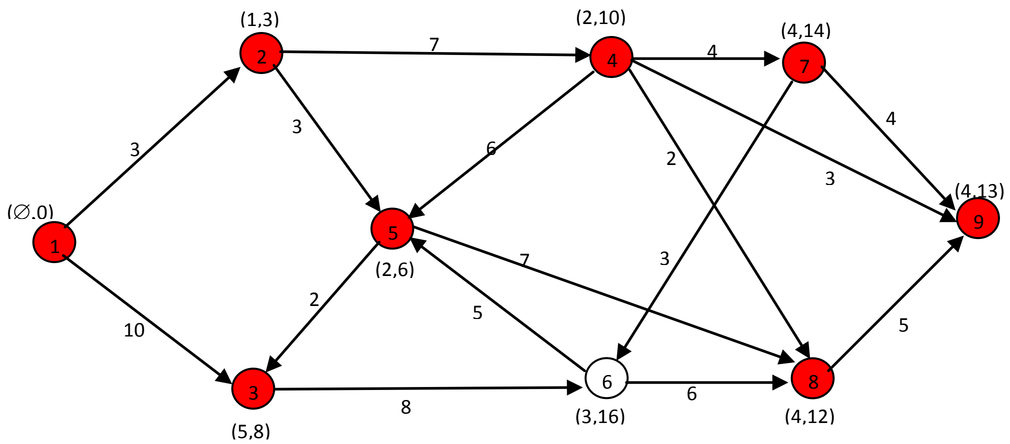
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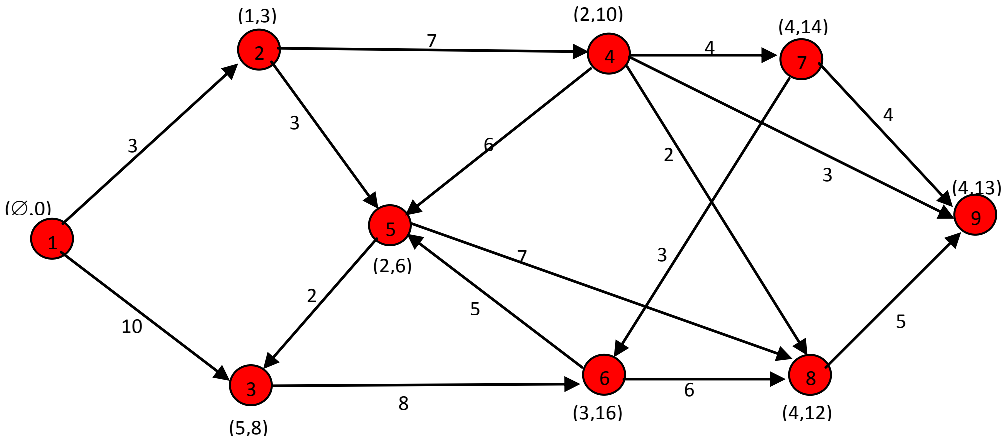
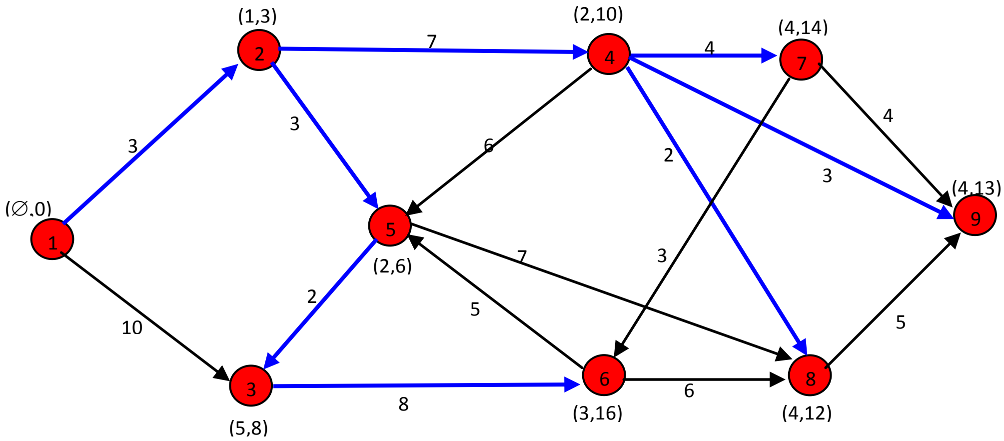


The Shortest Paths from 1 to all other nodes:



Conclusions:

In this paper, we have applied the Dijkstra method for solving the problem of route optimization. An illustrated presentation has been given to describe the method. It was found that the proposed concept is helpful in solving present as well as future real-life problems in the area of route optimization. The method has wide area of application in the field of tour and travels, school buses, milk distribution, medical care services etc.

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