A Fast and Reliable Dijkstra Algorithm for Online Shortest Path

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Abstract

The shortest path problem exists in a variety of areas. A well-known shortest path algorithm is Dijkstra's algorithm. In this paper, the concepts of network analysis with traffic issues are recognized. The condition of traffic in a city changes sometimes and there are usually large amounts of requests happen, it needs to be solved rapidly. The algorithm is developed by considering the various problems present in the existing modified Dijkstra's shortest path algorithms. In this MDSP algorithm, instead of a single parameter, multiple parameters were included to find the valid shortest path for road networks. The proposed algorithm is compared with the different existing algorithm which shows that proposed algorithm has better accuracy.

Key words - *Dijkstra's Algorithm, Shortest path, Alternative path, Traffic condition.*

I. INTRODUCTION

In modern car navigation systems, shortest path computation plays an important role and has been extensively studied. This paper helps in showing the best way to travel from one point to another and in doing so; the shortest path algorithm was made. The shortest path and the alternative path is computed based on the problem of getting the shortest path based on traffic conditions and it also gives alternative paths and the traffic count. This plays an important role in navigation systems as it can help to make a sensible decision and time-saving decisions [1]. To solve the shortest path problem of a graph with non-negative edge costs, gives shortest path tree, Dijkstra's Algorithm is used. This algorithm is mostly used in routing and other network connection protocols. For a given vertex in the graph, the algorithm gets by finding the costs of the shortest way from one source vertex to one destination vertex, once the shortest path reach to the destination vertex has been found the algorithm is then stopped [2,3]. The current widespread use of location-based services and GPS technologies has revived interest to develop a very fast and scalable shortest path algorithm to find a valid route for travelers over the road networks. Computing shortest path or distance between two points is one of the most fundamental and important key problems on road networks. Many people frequently face lot of problems while planning their trips with their own vehicles. Recent days many applications were developed to solve problem by finding an efficient route for the road networks. The past literature shows that various shortest path algorithm was developed to find the valid route for the road networks. But still the problem resists. Hence, the objective of the research is to propose a new shortest path algorithm to provide a better solution for the travelers over the road networks.

Due to the development of geographic information systems (GIS) technology it is possible to determine the fastest route and dispatch an emergency vehicle like ambulance, fire service vehicle etc. with the assistance of GIS. Because a link on a real road network in a city tends to possess different levels of congestion during different time periods of a day, and it is not an easy task to locate a shortest path [4]. Hence, the fastest route can only be determined in real time. In some cases, the fastest route has to be determined in a few seconds. Moreover, when large road networks are involved in an application, the determination of shortest paths on a large network can be computationally very difficult because many applications are involved to find the shortest path over the road networks.

II. RELATED WORK& BACKGROUND

In navigational assistance for such type of client presents more challenges not seen by guidance systems, due to the self-nature of the interactions [5]. The algorithms are part of all Navigation Indoor Models that provide guidance to indoor environments that are unknown. To work on an "Intelligent Map" path planning uses the Dijkstra's shortest path algorithms, that is based on a new data structure termed "cactus tree" which is shown on the relationships between the different objects that show an indoor environment, The need to design an application for the visually impaired, when to-date 'positioning and tracking' system cannot offer proper position information that is mostly required by this type of application as this research found. We saw

that the nature of transfer is that it needs more costs from one edge to its adjacent edge, this is the best-path problem for public transportation systems [6]. To store the scattered information related to transfer in indirect adjacent edges lists, it brings the space storage structure. Thus, it solves the issue of complex network graphs storage and to solve transit issue of the data model so it designs a new shortest path algorithm. We introduce a prior to simple graph depends on the Dijkstra's algorithm in terms of space and time as algorithm analysis exhibits. The complex road network finds a better route from one location to another location by a non-trivial task, as now a day there is increased in traffic [7]. There are many search algorithms that have been proposed to solve the problem of the shortest path, and the most well-known algorithm is Dijkstra's algorithm. In this paper, we study both uninformed and heuristic search to examine depend on some major cities [8]. To decrease the traveling distance and transportation costs, routing algorithms are used effectively. The proposed model is tested with sample dataset and we have simulated this on different working and traffic conditions. The Dijkstra's shortest path algorithm is the most commonly used to solve the single source shortest path problem today. For a graph figure 1 G (V, E), where V is the set of vertices and E is the set of edges, the running time for finding a path between two vertices varies when different data structure is used. This project uses binary heap to implement Dijkstra's algorithm although there are some data structures that may slightly improve the time complexity, such as Fibonacci heap that can purchase time complexity of O(V*log(V)).

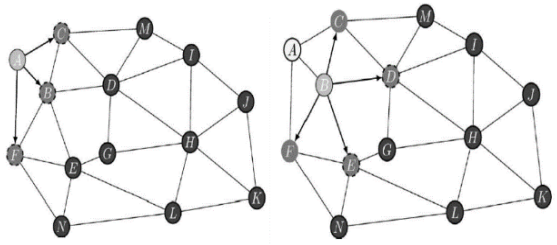

Figure 1: illustrate running path between vertices, where V is vertices and E is edge.

III. EXPERIMENTAL PROCESS

A. Proposed method

Computing shortest path or distance between two points is one of the most fundamental and important key problems on road networks. Many people frequently face a lot of problems while planning their trips with their own vehicles. Recently many applications were developed to solve a problem by finding an efficient route for the road networks. The past literature shows that various shortest path algorithm was developed to find the valid route for the road networks. But still, the problem resists. Hence, there is a need to propose a new shortest path algorithm to provide a better solution for the travelers over the road networks [9].

Due to the development of geographic information systems (GIS) technology, it is possible to determine the fastest route and dispatch an emergency vehicle like an ambulance, fire service vehicle etc. with the assistance of GIS. Because a link on a real road network in a city tends to possess different levels of congestion during different time periods of a day, and it is not an easy task to locate the shortest path. Hence, the fastest route can only be determined in real time. In some cases, the fastest route has to be determined in a few seconds. Moreover, when large road networks are involved in an application, the determination of shortest paths on a large network can be computationally very difficult because many applications are involved to find the shortest path over the road networks [10].

In the past literature, numerous shortest path algorithms like Dijkstra's algorithm, Bellman-Ford algorithm, a Search algorithm, the Floyd Warshall algorithm and Johnson's algorithm were developed. A thorough analysis was performed on the existing shortest path algorithms. Finally, it was observed that Dijkstra's shortest path algorithm is the most appropriate for calculating the shortest path in road networks. But the existing Dijkstra's shortest path algorithm needs some modification to improve the efficiency and to find a valid shortest path and to reduce the computational complexity. Hence, a new algorithm called Modified Dijkstra's Shortest Path algorithm (MDSP) is proposed. The proposed algorithm called Modified Dijkstra's Shortest Path algorithm (MDSP) is proposed. In this algorithm, multiple parameters were used to find the valid shortest path instead of using a single parameter. The efficiency of the MDSP algorithm is analyzed in terms of the shortest path by measuring its nodes and Time complexity. The run time of first for loop is O(V). In each iteration of the while loop, Extract_Min of the heap is logV. The inner for loop iterates each adjacent node of the current node, the total run time is O(E). Therefore, the time complexity of this algorithm is O ((V + E) *log(V) = O (E* log(V)). The correctness of this algorithm is well proved in [5]. As the number of nodes in a graph increases, the running time of the applied algorithm will become longer and longer. Usually, a road network of a city has more than 10^4 nodes. A fast-shortest path algorithm becomes more desirable Mohring et al. analyzed the existing different Dijkstra's shortest path algorithm. They found that in the existing Dijkstra's algorithm.

IV. RESULT AND DISCUSSION

The efficiency of the MDSP algorithm is verified in terms of nodes (it shows the shortest path) and Time using Lahore city database. For this experiment, a tool was developed using Java. In this tool existing and the proposed algorithm was

implemented. To perform an experiment analysis, we considered the Lahore database. The proposed algorithm is compared with the existing modified Dijkstra's algorithms namely, Dijkstra's Algorithm with Buckets (DKB), Dijkstra's Algorithm with Double Buckets (DKD), Dijkstra's algorithm with Approximate Buckets (DKA).

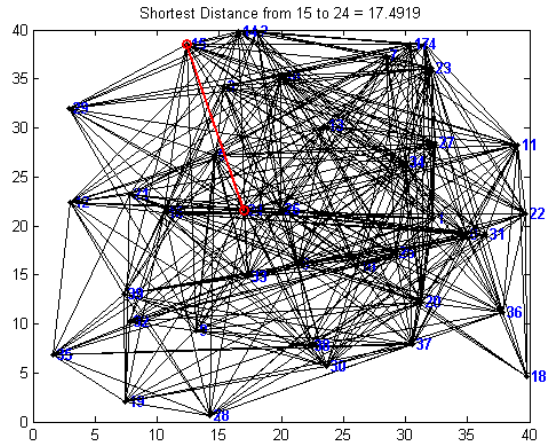

Figure 2: Shortest distance mapping from between 15 to 24 nodes.

To prove that the proposed MDSP algorithm efficiently select the shortest is achieved by computing the nodes taken to select the efficient shortest path we can see the shortest distance in figure 2. The nodes for the three different algorithms and our proposed algorithm were computed and their results are displayed in figure 3 showing the comparative analysis of the existing algorithm and the proposed algorithm MDSP. The comparative analysis shows that MDSP takes a minimum number of nodes than the other three existing algorithms.

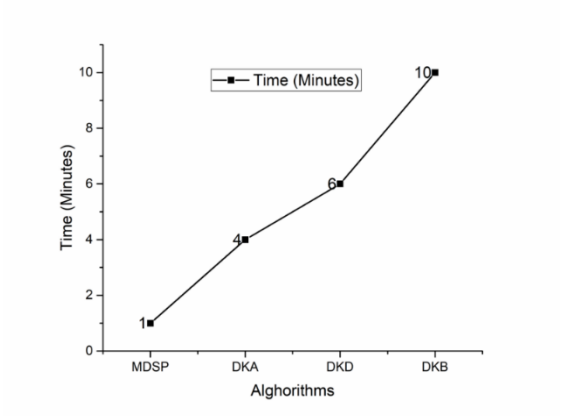

Figure 3: Nodes Comparison of MDSP, DKB, DKD, and DKA Algorithms.

The proposed MDSP algorithm reduces the time complexity. This is achieved by computing the time taken to find the efficient shortest path. A comparative analysis is performed with the existing three shortest path algorithms with the MDSP and the results are displayed in figure. The comparative analysis shows that MDSP takes lesser time to compute the efficient shortest path than the existing algorithms.

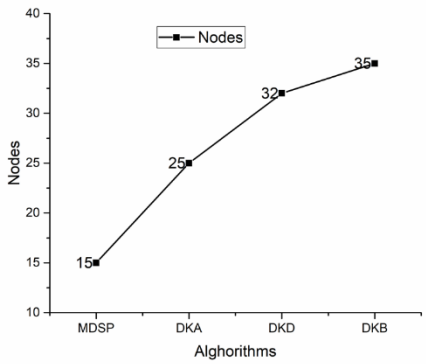

Figure 4: Time Comparison of MDSP, DKB, DKD, and DKA Algorithms.

From the figure 3 and 4 the result of the experiment analysis shows that the proposed shortest path algorithm MDSP finds the valid shortest path because compared to the existing algorithm it takes only minimum number of nodes and also it takes less computation time. Hence the proposed MDSP algorithms perform better than the existing three modified Dijkstra's shortest path algorithms.

V. CONCLUSION

Many research works are carried out to solve the shortest path problem for road networks. In this paper, a new shortest path algorithm namely MDSP was proposed with the multiple features. The algorithm is developed by considering the various problems present in the existing modified Dijkstra's shortest path algorithms. In this MDSP algorithm, instead of a single parameter, multiple parameters were included to find the valid shortest path for road networks. The results of the MDSP algorithms prove that, that the proposed algorithm efficiently finds the shortest path for the road network with minimum time complexity.

CONFLICTS OF INTEREST

There are no conflicts to declare.

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