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# Route Planning in Vanet By Comparitive Study of Algoriths

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***Abstract:** Route planning techniques is one of the main tasks of VRP (Vehicles route planning) which aims to find an optimal route from a starting point to a destination. Various techniques have been proposed so far to calculate shortest path in VANET by different researchers. This paper presents a study about the two well-known shortest path searching algorithms, which are used in routing. They are Bellman-Ford algorithm and Dijkstra algorithm. They were compared on the basis of their run time. The analysis of the comparison is given briefly to calculate the best available path which reduces the problem of delay. Calculating best shortest path gives useful information to registered users to travel on best available path. In this research work is done to evaluate the performance of proposed algorithms. The results of algorithm are compared to travel on best available path.*

***Keywords-** Vehicular Ad-Hoc network, Connection Availability, algorithms, Performance Evaluation, Route Planning*

## I. Introduction

VANET is a form of Mobile ad-hoc network, to provide communications among nearby vehicles and between vehicles. It is a technology that uses moving cars as nodes in a network (mobile network) so each vehicle can receive and transmit others messages through the wireless network, Evaluating shortest path in VANET deals with calculating best available path from source to destination for registered users. For calculating best available path an effective approach is needed. Computing the shortest path between two locations in road networks is a challenging task in vehicles routing area and related transportation, distribution and logistics industry. Choosing a suitable route planning algorithm from the numerous algorithms proposed. VANET has main two applications which are related to route planning and traffic safety. Route planning aims to provide drivers with real-time traffic information. As shown in Fig 1.

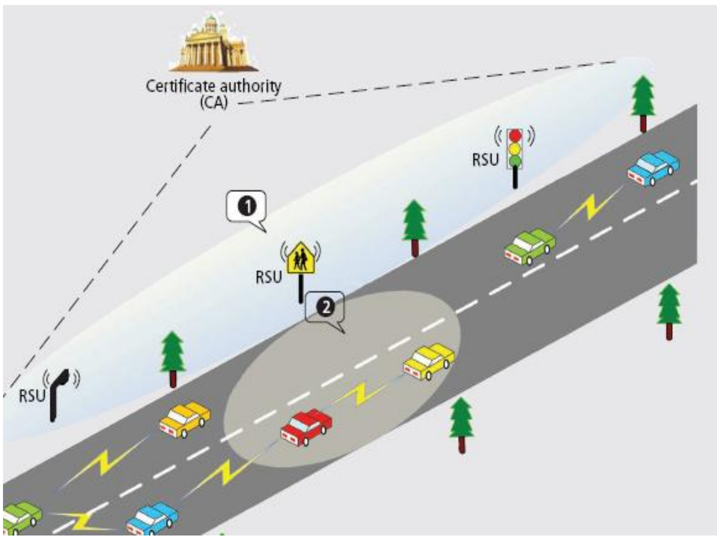


fig1: vanet model

In the recent years, vehicular networking has gained a lot of popularity among the industry and academic research community and is seen to be the most valuable concept for improving efficiency and safety for transportations. VANETs can be utilized for a broad range of safety and non-safety applications, allow for value added services such as vehicle safety, automated toll payment, traffic management, enhanced navigation, location-based services such as finding the closest fuel station, restaurant applications such as providing access to the Internet. Vehicle-to-vehicle communication systems are an important component of VANET and useful for a wide variety of applications that include incident detection, crash reporting, congestion warning and traveller information dissemination.
Fig2 will show the working scenario of evaluating best available shortest route in VANET. This will be adapted from Vi Tran Ngoc Nha et al. [16].

 

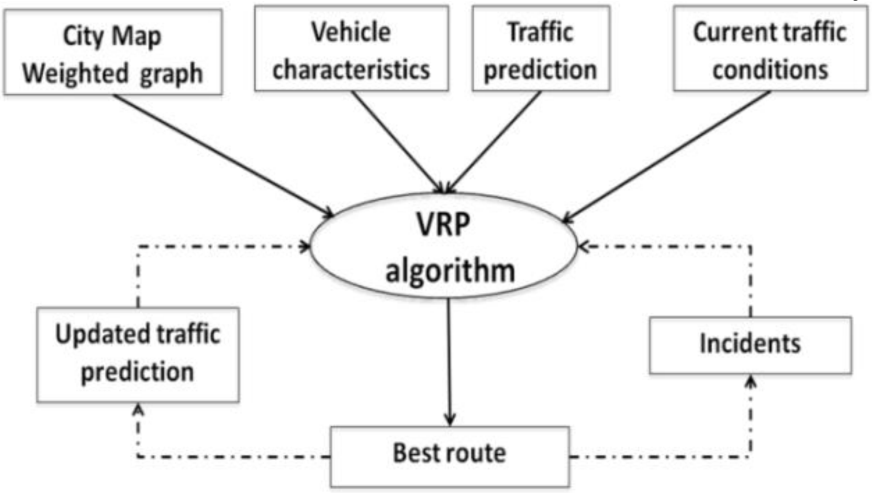


fig2: vehicles' route planning model

## II. Related Work

Panahi et al. [1] has discussed a GIS-based Dynamic Shortest Path Determination in Emergency Vehicles in which Accomplishing an effective routing of emergency vehicle will minimize its response time and will thus improve the response performance.

Jawalkar D.M et al. [2] has described Improving Road Accidence Monitoring Using Road Traffic Simulation in VANET in which the Intelligent Transportation Systems (ITS) are aimed at addressing critical issues like passenger safety and traffic congestion, by integrating information and communication technologies into transportation infrastructure and vehicles.

Sun et al. [3] has suggested roadside units deployment for efficient short-time certificate updating in VANET in which RSUs aided distributed certificate service is a promising approach for ensuring security and privacy preservation in VANET.

Ashutosh et al. [4] has suggested Application For Marketing Executives Implementing Dijkstra's Shortest Path Algorithm in Android Device which is used to find out the shortest path between two places on Google map. Dijkstra's algorithm is very fastest and easy to implement where there are no negative weights. GPS gives the current location of device.

Asano et al. [5] has discussed practical efficiency of the linear-time algorithm for the single source shortest path problem in which Thorup's linear-time algorithm for the single source shortest path problem consists of two phases: a construction phase of constructing a data structure suitable for a shortest path search from a given query source S.

Aljarboua et al. [6] has suggested geometric path planning for general Robot Manipulators in which a distance transform-based geometric path planning algorithm suitable for robots with vision capability. It shows that the proposed approach can reduce the computation time needed to find an optimal collision free path compared to other path planning algorithms.

Pruehs et al.[7] has discussed the implementation of Thorup's Linear Time Algorithm for Undirected Single-Source Shortest Paths with Positive Integer Weights in which Mikkel Thorup found the first deterministic algorithm to solve the classic single-source shortest paths problem for undirected graphs with positive integer weights in linear time and space.

Zongwei et al. [8] have suggested RFID Enabled Ubiquitous Query for Travel Information (UQTI) in Intelligent Transportation System over Mobile Relay Network (MRN) to facilitate the needed information access for drivers on the road. Design can achieve much higher packet delivery ratio in network with poor connectivity with tolerant delay. Rajive Bagrodia et al. [9] have suggested the accurate and efficient evaluation of vehicular network applications such as Intelligent Transportation System (ITS) is based on simulation which integrates transportation simulation and wireless network simulation. Simulation provides dynamic interaction between two simulation domains, which control the vehicles at runtime.

Yuh-Shyan et al. [10] has suggested Routing Protocols in Vehicular Ad Hoc Networks: A Survey and Future Perspectives in which the unicast protocol, multicast protocol, geocast protocol, mobicast protocol, and broadcast protocol is discussed which observed that carry-and-forward is the new and key consideration for designing all routing protocols in VANETs.

Nzouonta et al. [11] has suggested VANET routing on city roads using real-time vehicular traffic information in which a class of routing protocols called road-based using vehicular traffic (RBVT) routing, which outperforms existing routing protocols in city-based vehicular ad hoc networks (VANET). RBVT protocols leverage real-time vehicular traffic information to create road-based paths consisting of successions of road intersections that have, with high probability, network connectivity among them.

Vahid et al. [12] has described Vehicular Ad-Hoc Networks (VANET) applied to Intelligent Transportation Systems (ITS). Research work has focused on specific areas including routing, broadcasting, Quality of Service (QoS), and security, making VANETs a reality in the near future.

 

Rizzoli.et al. [13] has suggested A Simulation Tool for Combined Rail/Road Transport in intermodal Terminals. The presented terminal simulator plays the important role of the bimodal node in the transport network.

Karnadi et al. [14] has suggested Rapid generation of realistic mobility models for VANET a tool MOVE which is based on an open source micro-traffic simulator SUMO. MOVE allows user to quickly generate realistic mobility models for vehicular network simulations.

K Sampigethaya et al. [15] has suggested the CARAVAN: providing location privacy for VANET in which it is possible to locate and track a vehicle based on its transmissions, during communication with other vehicles or the road-side infrastructure. This type of tracking leads to threats on the location privacy of the vehicles. Ngoc Nha et al. [16] has suggested 'A comparative study of vehicles' routing algorithms for route planning in smart cities which identifying major issues and challenges associated with different protocols and selecting the optimal protocol. One of the main challenges in Vehicular ad-hoc network is of searching and maintaining an effective route for transporting data information.

Ying et al. [17] has suggested Privacy preserving broadcast message authentication protocol for VANETs in which simulation results demonstrate that PPBMA has superior performances in terms of packet loss rate and message delivery latency when compared to existing solutions.

Sona et al. [18] has suggested identifying major issues and challenges associated with different protocols and selecting the optimal protocol for future work. One of the main challenges in Vehicular ad-hoc network is of searching and maintaining an effective route for transporting data information.

## III. Problem Definition

This method deals with calculating best available path in VANET by comparative study of algorithm. The main goal of this research work is to reduce the problem of delay due to congestion and providing best available route to the registered users. To achieve the objectives we have taken RSUs as nodes in a graph and apply different shortest path technique on it. To evaluate the quantized difference between Dijsktra and Bellman ford different parameters will be used as distance, optimal route, cost of the route, and elapsed time etc.

## IV. Research Methodology

The main goal of query is concentrated on find best available path from source to destination by comparative study of algorithms. Three main steps are taken to find out best route which are explained as follows in flowchart. The proposed method is implemented using MatLab

*Step 1*: calculate an initial best route from the origin location of the vehicle to its desired destination according to a chosen algorithm (e.g. Dijkstra Algorithm etc.) as shown in fig3.

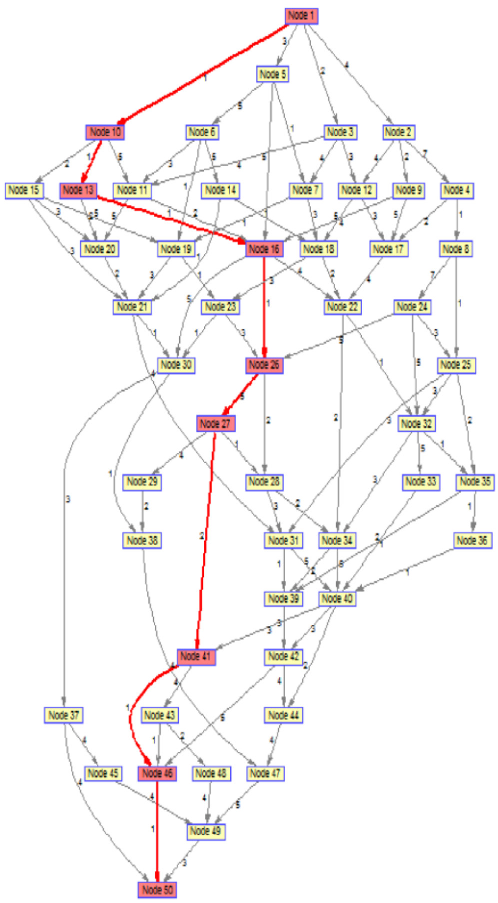

fig3: Best available shortest path which shows small distance covered in less time

*Step 2*: Re-calculate the best route due to an update in traffic conditions. In this case, whenever a vehicle reached an intersection, the traffic conditions are checked for any update. If there is an update impacting at least on link in the best route, the affected links are removed and the route planning algorithm is re-applied to calculate a new best route for the vehicle. Otherwise, the vehicle carries on its journey.

*Step 3*: Is the destination location reached? If no, the step 2 is repeated until the vehicle reaches its last intersection and arrives at its desired destination.

The flowchart in Fig 4 shows research methodology.

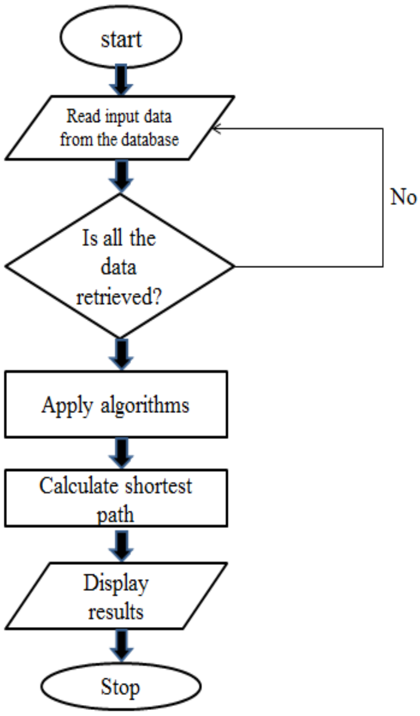


Fig4: Research methodology

## V. Performance Analysis

The main goal is to find the shortest distance from source to destination by comparative study of algorithms. This will give us the best available path or route to reach at destination so that the problems of delay can be reduced.

In this we have to check following parameters:**-**

***1)*** *Optimal path*: RSU should provide user information about safer and more comfortable driving route. Based on this metric, route planning algorithm aims to find a vehicle route satisfying driver's preference the most.

*2)* *Travel distance*: Finding the shortest path means searching the route from the origin location to the destination through which the vehicle travels the shortest distance.

*3)* *Travel cost:* The travel cost defines the total cost from source to destination. Suppose cost unit is Rs 2 per kilometre.

Cost= Distance x Cost unit

*4***)** *Elapsed time*: The travel time is another criterion for route planning algorithm. The fastest route is the path through which the vehicle can reach its destination with within minimum travel time.

## VI. Comparison Between Dijkastra And Bellman Ford

Table 1: difference between Dijkastra and Bellman ford algorithm

| **Parameter** | **Dijkastra** | **Bellman ford** |
|---|---|---|
| **Overheads** | Less | More |
| **Scalability** | More | Less |
| **Quality of the best available route.** | More | Less |
| **Negative edges** | No | Yes |
| **Delay** | Less | More |

 

*1) Overheads:* Overhead consists of extra computations that are to be performed to get the results. Dijkastra gives better results than Bellman ford.

*2) Scalability:* Another factor is scalability. The scalability of an algorithm reflects the decrease of performance when the size of the road network gets larger.

*3) Quality of the best route:* This is used to compare the different best routes in order to determine which algorithm is calculating the closest solution to the optimal route.

*4) Negative Edges:* Dijkastra does not work on negative values but bellman ford work on negative values.

*5) Delay:* The time taken by Bellman ford algorithm is small as compare to Dijkastra algorithm.

## VII. Result and Performance Analysis

The experiment is performed by taking 20 nodes. The results show that the bellman ford gives better results as compared to the Dijkastra to reach at destination. By Dijkastra algorithm the distance covered by a vehicle is smaller as compare to Bellman ford and time it takes to reach at destination is also less as compare to Dijkastra. Bellman ford work works on negative as well as positive edges but Dijkastra only work for positive edges. Bellman-Ford requires O(|V|·|E|) time, while Dijkstra requires O(|E| + |V|log|V|) time, We have concentrated on finding shortest path in small time. The table illustrates the performance of Bellman ford and Dijkastra algorithms. As a result best available path is found in less time.

Table 2: Bellman ford algorithm vs Dijkstra's that shows the optimal path

| **Source** | **Destination** | **Bellman ford path** | **Dijkstra's path** |
|---|---|---|---|
| 1 | 50 | 1,2,4,8,25,32,33,40,41,46,50 | 1,10,15,21,30,37,50 |
| 1 | 47 | 1,3,7,19,21,30,38,47 | 1,5,16,30,38,47 |
| 1 | 44 | 1,2,12,18,22,32,34,40,44 | 1,10,13,16,22,34,40,44 |
| 1 | 41 | 1,2,9,17,22,34,40,41 | 1,10,11,16,26,27,41 |
| 1 | 38 | 1,2,9,16,30,38 | 1,10,15,21,30,38 |
| 1 | 35 | 1,2,9,17,22,32,35 | 1,2,4,8,25,35 |
| 1 | 32 | 1,10,13,16,22,32 | 1,3,12,18,22,32 |
| 1 | 29 | 1,5,6,19,23,26,27,29 | 1,5,16,2627,29 |
| 1 | 26 | 1,10,13,16,26 | 1,5,16,26 |
| 1 | 23 | 1,5,6,14,18,23 | 1,3,7,18,23 |

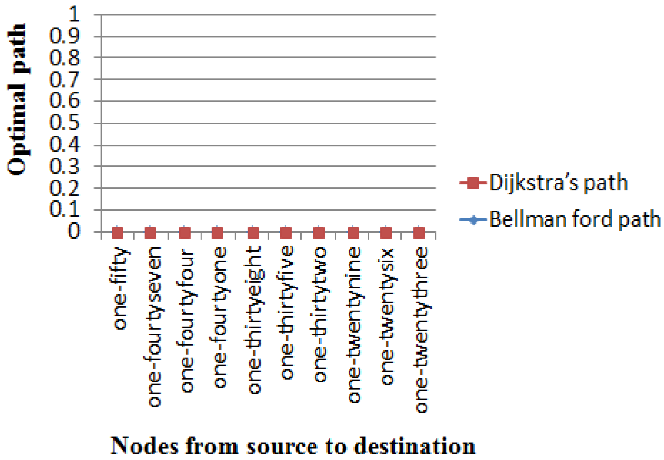


fig5: Nodes from source to destination vs optimal path

 

Table 3: Bellman ford algorithm vs Dijkstra that shows the distance covered

| **Source** | **Destination** | **Bellman ford Distance** | **Dijkstra's Distance** |
|---|---|---|---|
| 1 | 50 | 4 | 15 |
| 1 | 47 | 3 | 13 |
| 1 | 44 | 9 | 13 |
| 1 | 41 | 3 | 14 |
| 1 | 38 | 7 | 13 |
| 1 | 35 | 15 | 14 |
| 1 | 32 | 9 | 12 |
| 1 | 29 | 6 | 15 |
| 1 | 26 | 2 | 9 |
| 1 | 23 | 1 | 10 |

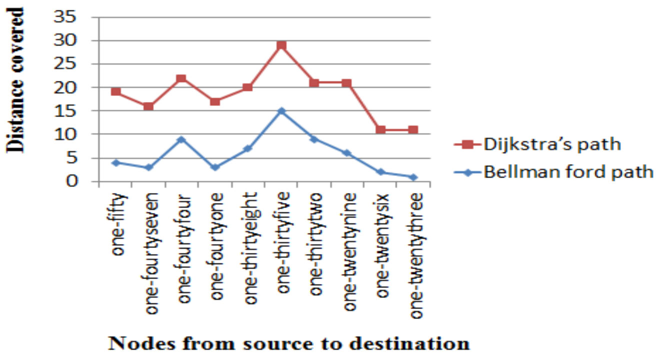


fig6: Nodes from source to destination vs distance covered

Table4: Bellman ford algorithm vs Dijkastra that shows the cost of best available path

| **Source** | **Destination** | **Bellman ford route cost** | **Dijkstra's route cost** |
|---|---|---|---|
| 1 | 50 | 8 | 30 |
| 1 | 47 | 6 | 26 |
| 1 | 44 | 18 | 26 |
| 1 | 41 | 6 | 28 |
| 1 | 38 | 14 | 26 |
| 1 | 35 | 30 | 28 |
| 1 | 32 | 18 | 24 |
| 1 | 29 | 12 | 30 |
| 1 | 26 | 4 | 18 |
| 1 | 23 | 2 | 20 |

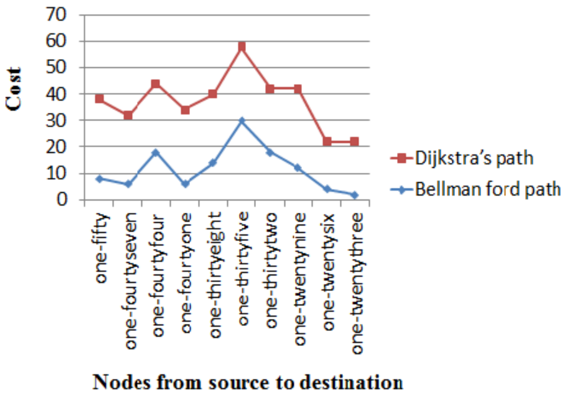


fig7: Nodes from source to destination vs cost of best available route

 

Table 5: Bellman ford algorithm vs Dijkstra that shows the elapse time

| Source | Destination | Bellman ford time | Dijkstra's time |
|---|---|---|---|
| 1 | 50 | 27.87 | 5.05 |
| 1 | 47 | 6.85 | 4.58 |
| 1 | 44 | 5.80 | 4.95 |
| 1 | 41 | 8.57 | 4.88 |
| 1 | 38 | 6.87 | 4.21 |
| 1 | 35 | 8.35 | 5.29 |
| 1 | 32 | 6.93 | 5.30 |
| 1 | 29 | 5.75 | 4.49 |
| 1 | 26 | 6.12 | 5.59 |
| 1 | 23 | 4.98 | 4.38 |

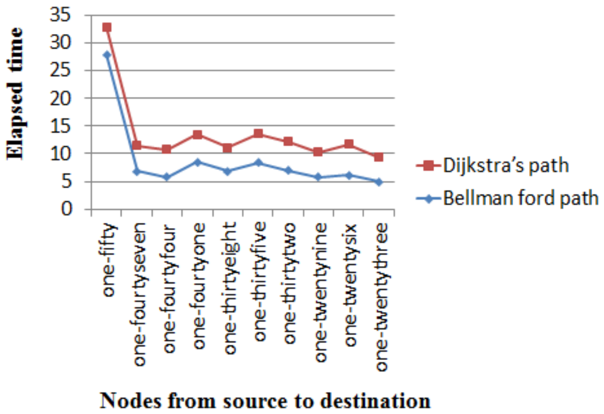


fig8: Nodes from source to destination vs Elapsed time

## VIII. Conclusion

It is shown that "Route planning in VANET by comparative study of algorithms" that provides better results. Suitable simulation is done in MATLAB by considering the problem of delay during computing the best available path. A comparison has been drawn among available shortest path algorithms in VANET. To achieve the objectives we have taken RSUs as nodes in a graph and apply different shortest path technique on it. It is shown in the results that Dijkastra provides better results than the Bellman ford algorithm. The time and distance covered by Dijkastra is less as compare to Bellman ford. It provides multiple parameters like distance, elapsed time, optimal route and cost out of which the user can choose one. The user can also view the best available route between a source-destination pair. During the design process some assumptions have been made such as the congestion factor may vary in real time scenario and may be affected by traffic jams etc. Also while calculating the time it is assumed that the user would move towards the desired destination, without any stoppages in between. In the bus routes, it is assumed that buses are always available at the node when the passenger arrives; the arrival time of the buses has not been taken into consideration.

## Acknowledgement

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