ROUTE OPTIMIZATION FOR EMERGENCY

VEHICLES

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**ABSTRACT -** In this modern era getting struck in busy traffic for hours makes human impatient. Movement of emergency vehicles among these busy routes has become more tougher. So there is an immediate need for an optimized traffic flow control. This work delivers the study of traffic flow analysis in busy areas. Implementation of a suitable algorithm to analyze quick route to reach the destination for emergency vehicle is being analyzed here. This method is based on graph theory, where the data in the data sheet is first converted into graph with nodes and edges. Here, nodes represent the area and the edge represents the time required to travel through. The edges are given with different weight i.e. the distance and the traffic percentage in that route. Based on the value of these data the total time required to travel through the route is calculated. Based on this calculated value the shortest path is obtained by using the Dijkstra’s algorithm.

**INTRODUCTION**

Approximately 60% of the people get struck in the traffic in their day-to- day life which results in major problems. Transport sector is important for the economic growth of our nation. Because of these delays in transportation sector it leads to some critical situation that affect the business of many private and public sectors. The delay and loss of a business sector is very mere when compared to the delay in an emergency vehicle as it completely deals with human lives. Even a small delay will lead to critical situation of a persons, sometimes may also leads to death. To introduce an algorithm that preciously finds the shortest path and guide the emergency vehicle to reach the destination at faster rate. The solution helps not only emergency vehicle but also the common people who wishes to reach their destination on time. As a result, no one can have to wait for a long time in the traffic by finding the better ways to reach their destination.

**RELATED WORKS**

[1] Agafonov, A., & Myasnikov, V. (2017). Efficiency comparison of the routing algorithms used in centralized traffic management systems. Procedia Engineering, Vol. 201, 265-270. The paper [1] “Efficiency comparison of the routing algorithms used in centralized traffic management systems” is to compare the efficiency of vehicle routing algorithms used in transport networks. We consider a centralized approach, in which the calculation of the routes of all vehicles is performed in a centralized traffic management system. We investigate routing algorithms based on the shortest path algorithm in a static time-dependent network, as well as the effect of the rerouting procedure on the total travel time.

[2] Agafonov, A., & Myasnikov, V. (2018). Vehicle routing algorithms based on a route reservation approach. Journal of Physics: Conference Series, Vol. 1069, 1-9.The paper [2] “Vehicle routing algorithms based on a route reservation approach” is Traﬃc congestion remains a serious problem in transportation networks. Widely used navigation systems can only react to the presence of traﬃc jams but not to prevent their creation.One of the possibilities to prevent congestion is to manage road traﬃc within the urban area. This work considers a route reservation approach with possibility to reroute a vehicle during a journey.This approach decomposes road segments into time-spatial slots and for every vehicle it makesthe slots reservation for the corresponding route.

[3] Mu, H., Yu, J., & Liu, L. (2009). Shortest path algorithm for road network with traffic restriction. IEEE 2nd International Conference on Power Electronics and Intelligent Transportation System, China.The paper [3] “Shortest path algorithm for road network with traffic restriction” is based on graph theory, where a road network map is first converted to a graph with nodes and edges where the edges represent the roads and the nodes represent the various road intersections. The roads are given various weights depending on their distance and traffic density, and the time a motorist would take to move from one point to another is estimated. A suitable routing algorithm, which in this case is the Dijkstra’s algorithm is applied on the weighted graph.

[4] Nha, V., Djahel, S., & Murphy, J. (2012). A comparative study of vehicles' routing algorithms for route planning in smart cities. IEEE First International Workshop on Vehicular Traffic Management for Smart Cities, Ireland.The paper [4] “ A comparative study of vehicles' routing algorithms for route planning in smart cities” Vehicle routing problem (VRP) is a generic name referring to optimization problems in transportation, distribution and logistics industry. They mainly focus on serving a number of customers by a number of vehicles. Route planning techniques is one of the main tasks of VRP which aims to ﬁnd an optimal route from a starting point to a destination on a road map[5] Noor Afiza Mat Razali, Nuraini Shamsaimon, Khairul Khalil Ishak. Traffic flow prediction using machine learning and deep learning. Journal of Big Data volume 8, Article number: 152 (2021), Dec 04, 2021.

The paper [5] “Traffic flow prediction using machine learning and deep learning” The development of the Internet of Things (IoT) has produced new innovative solutions, such as smart cities, which enable humans to have a more efficient, convenient and smarter way of life. The Intelligent Transportation System (ITS) is part of several smart city applications where it enhances the processes of transportation and commutation. ITS aims to solve traffic problems, mainly traffic congestion. In recent years, new models and frameworks for predicting traffic flow have been rapidly developed to enhance the performance of traffic flow prediction, alongside the implementation of Artificial Intelligence (AI) methods such as machine learning (ML). To better understand how ML implementations can enhance traffic flow prediction, it is important to inclusively know the current research that has been conducted. The results can be compared with baseline studies to determine the accuracy of these techniques.

[6] Idriss Idrissi, Mostafa Azizi, Omar Moussaoui. IoT security with Deep Learning-based Intrusion Detection Systems. 4th ICDS , 21-23, October 2020.The [paper [6] “IoT security with Deep Learning-based Intrusion Detection Systems” focuses on the state-of-the-art of IoT security threats and vulnerabilities by conducting a classification of some wellknown security threats according to Cisco IoT reference model architecture. We also make a review of existing works in the area of IoT security targeting more particularly the Intrusion Detection Systems based on Deep Learning (DL) techniques, which are rising as emerging techniques in various fields including cybersecurity. This state-of-the-art and its findings can serve as a potential basis for future research directions.

[7] N. Nithya, B. S. Kumar and S. Suriya, "Smart Traffic Density and Emergency Signal Controller," 2022 International Conference on Power, Energy, Control and Transmission Systems (ICPECTS), Chennai, India, 2022, pp. 1-5, doi: 10.1109/ICPECTS56089.2022.10047520.The paper [7] “Smart Traffic Density and Emergency Signal Controller” The project is aimed at designing a density based dynamic traffic signal system where the timing of signal will change automatically on sensing the traffic density at any junction. Traffic congestion is a severe problem in most cities across the world and therefore it is time to shift more manual mode or fixed timer mode to an automated system with decision making capabilities.

[8] Guangjie Han, Hao Wang, Mohsen Guizani, Sammy Chan. KCLP: A kMeans Cluster-Based Location Privacy Protection Scheme in WSNs for IoT. IEEE Wireless Communications, December 2018.The paper [8] “A kMeans Cluster-Based Location Privacy Protection Scheme in WSNs for IoT” is focussed on location privacy, which is a major security issue in WSNs, and propose a k-means cluster-based location privacy (KCLP) protection scheme for IoT. To protect the source location, fake source nodes are used to simulate the function of the real sources. Then, to protect the sink location privacy, fake sink nodes and a specific transmission pattern are utilized. In order to improve safety time, a k-means cluster is applied to create clusters and fake packets that must pass through the area. Compared to contrasting algorithms, the KCLP scheme can increase the safety time and reduce delay at minor expense in energy consumption.

[9] W. Yue, C. Li, G. Mao, N. Cheng and D. Zhou, "Evolution of road traffic congestion control: A survey from perspective of sensing, communication, and computation," in China Communications, vol. 18, no. 12, pp. 151-177, Dec. 2021, doi: 10.23919/JCC.2021.12.010.The paper [9] “Evolution of road traffic congestion control: A survey from perspective of sensing, communication, and computation” Road traffic congestion can inevitably degrade road infrastructure and decrease travel efficiency in urban traffic networks, which can be relieved by employing appropriate congestion control. According to different developmental driving forces, in this paper, the evolution of road traffic congestion control is divided into two stages. The ever-growing number of advanced sensing techniques can be seen as the key driving force of the first stage, called the sensing stage, in which congestion control strategies experienced rapid growth owing to the accessibility of traffic data.

[10] B. Roy, S. Patnaik and P. Dutta, "Congestion Detection Techniques in Road Network," 2021 Smart City Challenges & Outcomes for Urban Transformation (SCOUT), Bhubaneswar, India, 2021, pp. 252-255,doi: 10.1109/SCOUT54618.2021.00060.The paper [10] “Congestion Detection Techniques in Road Network” is to analyse traffic problems at a suitable intersection and suggesting an alternate solution. the same volume of traffic bifurcate to move at two different levels and leaves no chance for any accident. On implementation of the project, along with smart traffic and the intelligent transportation system, the present and future demands of the traffic flow along the route will be satisfied without any distraction in traffic management.

[11] X. Duan, J. Xu, Y. Chen and R. Jiang, "Analysis of influencing factors on urban traffic congestion and prediction of congestion time based on spatiotemporal big data," 2020 International Conference on Big Data, Artificial Intelligence and Internet of Things Engineering (ICBAIE), Fuzhou, China, 2020, pp. 75-78, doi: 10.1109/ICBAIE49996.2020.00022.The paper [11] “Analysis of influencing factors on urban traffic congestion and prediction of congestion time based on spatiotemporal big data” the centroids of the grid regions are abstracted as nodes, and the dynamic correlations between the nodes are expressed in the form of adjacency matrix. Then, Graph Convolutional Neural Network is used to capture the spatial correlation between regions and a two-layer long and short-term feature model (DSTM) is used to capture the temporal correlation between regions. Finally, the DSGCN outperforms other baseline models and has higher accuracy for traffic congestion prediction as demonstrated by experiments on real PeMS datasets.

[12] K. Rajan and K. Sampath Kumar, "Optimization of Traffic Congestion in Smart Cities Using Residual Convolutional Neural Network," 2022 IEEE International Conference on Data Science and Information System (ICDSIS), Hassan, India, 2022, pp. 1-4,doi: 10.1109/ICDSIS5513.2022.9915860.The paper [12] “Optimization of Traffic Congestion in Smart Cities Using Residual Convolutional Neural Network” develops a ResNet approach using Internet of Things (IoT) that controls the traffic congestion in smaller congestion area. The real-time analysis generates the traffic simulation environment in a simulator using the real time data i.e., finding number of vehicles getting congested from the images captured via IoT image acquisition module. The simulation generation using ResNet generates the control signal to real-time environment to quickly clear the congestion in that area.

**PROPOSED SYSTEM**

The system is used to develop the section of a road network where the user gives the input as the origin and the destination. Thus the system applies the dijkstra’s algorithm to give the output as the fastest route the approximate time to reach the destination. The output results in each and every area that has been covered to travel from origin to destination along with their respective distance and time required to cross that corresponding intermediate areas. e, the algorithm considers the route with the minimum time and returns it together with the total approximate time in minutes. All the areas in that particular shortest route is calculated and shown in the output. This helps us to keep track the areas and reach the destination by easily identifying the routes and areas. This system helps not only the regular vehicle but also the emergency vehicle to reach the hospital very soon and helps the patient to save their lives.

The main reason to final this concept is to detect the traffic flow control in an efficient way by calculating the total time required to travel from one place to another rather than finding the distance between the two places. It is more efficient then the existing Dijkstra’s algorithm by producing the accurate result with the calculation of total time required to cover the required distance between the two places. This system finds the shortest path on the basis of both the distance between the two nodes and also the traffic congestion in that particular areas.

**WORKING**

The design of our research requires the real time complete data set and conversion of this data set into the graph with nodes and edges. The data set must consist of the necessary column that has been implemented in the algorithm. The data set must contain the source information, destination information, their corresponding latitude and longitude and their distance between the source and the destination and their corresponding traffic percentage compared to standard rates. With these values on the data set, it is first converted into corresponding graph with nodes and edges. The nodes represent the area of source and destination and the edge represents the time required to reach the destination through the particular route. Once the graph is ready the dijktra’s algorithm is used to determine the shortest path between the source and the destination.

A section of the data set shown in the figure is converted into the graph. This section of roads is chosen for the purposes of demonstrating the working of the algorithm. This graph is used for the detection of shortest path for transportation. This data set contains the information about the distance and weightage of the traffic percentage in that particular route. After the formation of graph, the user have to enter the source and the destination place. The algorithm will check the availability of that particular place in the graph. If there is no place available in that graph, then the algorithm will through an error indicating that there is place in that data set. After recognization of the source and destination the code will enter into the dijkstra’s algorithm to find the shortest path. The algorithm will take the graph, source and destination as an input and will find out the shortest path to reach the destination from the source.

**GRAPH ALGORITHM**

In the graph module, a detailed data about the road network is first converted into the graph. The time taken to move from one location to another is obtained from the calculation of the distance and weightage of the traffic in that route along with the standard average speed calculation. Dijkstra’s algorithm is applied on the graph where one input is taken from the origin and the other from the destination and the algorithm returns the fastest route and the shortest time a vehicle is likely to take. Several tests are conducted by running the program at different times.

**DIJKSTRA’S ALGORITHM**

Dijkstra's Algorithm finds the shortest path between a given node (which is called the "source node") and all other nodes in a graph. This algorithm uses the weights of the edges to find the path that minimizes the total distance (weight) between the source node and all other nodes. It is a single source shortest paths algorithm. It means that it finds the shortest paths from a single source vertex to all other vertices in a graph. It is a greedy algorithm and works for both directed and undirected, positively weighted graphs (a graph is called positively weighted if all of its edges have only positive weights). STEPS

1. Mark the ending vertex with a distance of zero. Designate this vertex as current.

2. Find all vertices leading to the current vertex. Calculate their distances to the end. Since we already know the distance the current vertex is from the end, this will just require adding the most recent edge. Don’t record this distance if it is longer than a previously recorded distance.

3. Mark the current vertex as visited. We will never look at this vertex again.

4. Mark the vertex with the smallest distance as current and repeat from step 2.

**TIME ALGORITHM**

Time algorithm is used to develop the section of a road network where the user gives the input as the origin and the destination. Thus, the system applies the Dijkstra’s algorithm to give the output as the fastest route the approximate time to reach the destination. The output results in each and every area that has been covered to travel from origin to destination along with their respective distance and time required to cross that corresponding intermediate areas. The algorithm considers the route with the minimum time and returns it together with the total approximate time in minutes. All the areas in that particular shortest route is calculated and shown in the output. This helps us to keep track the areas and reach the destination by easily identifying the routes and areas. The system is used to give the output as the fastest route the approximate time to reach the destination. The output results in each and every area that has been covered to travel from origin to destination along with their respective distance and time required to cross that corresponding intermediate areas. The algorithm considers the route with the minimum time and returns it together with the total approximate time in minutes

The time is used to calculate the time taken to move from one location to another is obtained from the calculation of the distance and weightage of the traffic in that route along with the standard average speed calculation.

T = D / (S – ((S\*P)/100))

D - Distance between two nodes

P - Percentage of traffic flow

S - Average speed

T – Time taken to reach destination

**CONCLUSIONS**

**RESULTS AND DISCUSSIONS** The system is used to develop the section of a road network where the user gives the input as the origin and the destination. Thus, the system applies the dijkstra’s algorithm to give the output as the fastest route the approximate time to reach the destination. The output results in each and every area that has been covered to travel from origin to destination along with their respective distance and time required to cross that corresponding intermediate areas. The algorithm considers the route with the minimum time and returns it together with the total approximate time in minutes. As seen in the result, all the areas in that particular shortest route is calculated and shown in the output. This helps us to keep track the areas and reach the destination by easily identifying the routes and areas. This system helps not only the regular vehicle but also the emergency vehicle to reach the hospital very soon and helps the patient to save their lives.

**CONCLUSION AND FUTURE ENHANCEMENTS** In conclusion, it is evident that in the current world with developing technology, efficiency and reliability are critical when developing new systems and implement in the real world. There is a high need to save time especially on the roads during critical situation and also obtain reliable information on the traffic situation that can be relied upon. The system developed shows that the fastest route from one point to another can be determined with a suitable algorithm and also helps to save many lives by its efficient traffic flow control methodology. This meets the main objective of the paper.

**REFERENCES**

[1]Agafonov, A., & Myasnikov, V. (2017). Efficiency comparison of the routing algorithms used in centralized traffic management systems. Procedia Engineering, Vol. 201, 265-270.

[2]Agafonov, A., & Myasnikov, V. (2018). Vehicle routing algorithms based on a route reservation approach. Journal of Physics: Conference Series, Vol. 1069, 1-9.

[3]Mu, H., Yu, J., & Liu, L. (2009). Shortest path algorithm for road network with traffic restriction. IEEE 2nd International Conference on Power Electronics and Intelligent Transportation System, China.

[4]Nha, V., Djahel, S., & Murphy, J. (2012). A comparative study of vehicles' routing algorithms for route planning in smart cities. IEEE First International Workshop on Vehicular Traffic Management for Smart Cities, Ireland.

[5]Noor Afiza Mat Razali, Nuraini Shamsaimon, Khairul Khalil Ishak. Traffic flow prediction using machine learning and deep learning. Journal of Big Data volume 8, Article number: 152 (2021), Dec 04, 2021.

[6]Idriss Idrissi, Mostafa Azizi, Omar Moussaoui. IoT security with Deep Learning-based Intrusion Detection Systems. 4th ICDS , 21-23, October 2020.

[7]N. Nithya, B. S. Kumar and S. Suriya, "Smart Traffic Density and Emergency Signal Controller*,"* 2022 International Conference on Power, Energy, Control and Transmission Systems (ICPECTS)*,* Chennai, India, 2022, pp. 1-5, doi: 10.1109/ICPECTS56089.2022.10047520.

[8]Guangjie Han, Hao Wang, Mohsen Guizani, Sammy Chan. KCLP: A kMeans Cluster-Based Location Privacy Protection Scheme in WSNs for IoT. IEEE Wireless Communications, December 2018.

[9]W. Yue, C. Li, G. Mao, N. Cheng and D. Zhou, "Evolution of road traffic congestion control: A survey from perspective of sensing, communication, and computation," in China Communications, vol. 18, no. 12, pp. 151-177, Dec. 2021, doi: 10.23919/JCC.2021.12.010.

[10]B. Roy, S. Patnaik and P. Dutta, "Congestion Detection Techniques in Road Network*,"* 2021 Smart City Challenges & Outcomes for Urban Transformation (SCOUT)*,* Bhubaneswar, India, 2021, pp. 252-255, doi: 10.1109/SCOUT54618.2021.00060.

[11]M. Akhtar, M. Raffeh, F. ul Zaman, A. Ramzan, S. Aslam and F. Usman, "Development of congestion level based dynamic traffic management system using IoT," 2020 International Conference on Electrical, Communication, and Computer Engineering (ICECCE)*,* Istanbul, Turkey, 2020, pp. 1-6, doi: 10.1109/ICECCE49384.2020.9179375.

Informatics (SAMI)*,* Poprad, Slovakia, 2022, pp. 000121- 000126, doi: 10.1109/SAMI54271.2022.9780813.

[15]K. Rajan and K. Sampath Kumar, "Optimization of Traffic Congestion in Smart Cities Using Residual Convolutional Neural Network," 2022 IEEE International Conference on Data Science and Information System (ICDSIS*)*, Hassan, India, 2022, pp. 1-4,doi: 10.1109/ICDSIS55133.2022.9915860.

[16]N. Shukla, D. Garg, S. Singh and C. Upadhyaya, "Traffic Congestion Management using Camera and Geolocation," 2022 6th International Conference on Trends in Electronics and Informatics (ICOEI)*,* Tirunelveli, India, 2022, pp. 68-73, doi:10.1109/ICOEI53556.2022.9776886

[12]Z. He, B. Ren and C. He, "Identification of influencing factors of urban traffic congestion based on ordered Logistic regression," 2022 7th International Conference on Intelligent Computing and Signal Processing (ICSP), Xi'an, China, 2022, pp. 914-918, doi: 10.1109/ICSP54964.2022.9778490.

[13]M. Akhtar, M. Raffeh, F. ul Zaman, A. Ramzan, S. Aslam and F. Usman, "Development of congestion level based dynamic traffic management system using IoT," 2020 International Conference on Electrical, Communication, and Computer Engineering (ICECCE)*,* Istanbul, Turkey, 2020, pp. 1-6, doi: 10.1109/ICECCE49384.2020.9179375.

[14]X. Duan, J. Xu, Y. Chen and R. Jiang, "Analysis of influencing factors on urban traffic congestion and prediction of congestion time based on spatiotemporal big data*,"* 2020 International Conference on Big Data, Artificial Intelligence and Internet of Things Engineering (ICBAIE*)*, Fuzhou, China, 2020, pp. 75-78, doi: