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Fleet Management and Vehicle Routing Plan using Dijkstra's Shortest Path Algorithm

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Abstract:- This study offers a review of the shortest-path problem-solving algorithms in fleet management system. In a graph, the shortest path problem can be solved using a variety of algorithmic approaches,and there are significant variations between them. It is quite challenging to find both the shortest or fastest path of the optimal route, which takes the least amount of time, as well as the shortest path on the graph with all of its benefits and drawbacks. The algorithm must be able to draw conclusions based on additional characteristics, such as the length of each point's distance, the state of the path between points, and the volume of traffic at each point, in order to determine which is the most effective.

I. INTRODUCTION

A sustainable fleet management plan aims to reduce environmental effects by using cleaner cars and fuels, practicing fuel-efficient operation and driving, and minimizing the amount of traffic the fleet contributes to on the road. The fleet performs a number of tasks during emergency and development activities. For some businesses, managing their fleet of vehicles acts as both their main asset and the core activity in their value chain.Fleet Management (FM) systems can access common network networks such as the global positioning system (GPS) and the worldwide system for mobile communication (GSM). Due to its low cost and simplicity of use for reliably delivering data over existing networks, GSM technology has become more and more widespread. People all across the world can get location and time information via the Global Positioning System (GPS), a global navigation satellite system. The tracking, routing, and real-time fleet management capabilities of both systems are very strong.

In the field of vehicle routing and the related transportation, distribution, and logistics industries, determining the shortest route between two points on a road network is a difficult task. In many transportation applications using actual road networks, selecting a good route planning method from the various algorithms proposed in the literature is a crucial problem [1]. This is because in such networks, a number of dynamic characteristics (such as the degree of traffic congestion, unforeseen events, weather conditions, etc.) have an impact on how effectively the applied algorithms perform. These algorithms should therefore be improved to incorporate these dynamic characteristics and update the selected shortest path appropriately.

II. LITERATURE REVIEW

Fleet management is a service that helps companies that rely on transportation to, among other things, decrease total transportation and personnel expenses, boost efficiency and productivity, and assure compliance with all applicable legal requirements (duty of care). These tasks might be carried out domestically or by a fleet management company that is outsourced.Fleet management is the proactive management of an organization's vehicle assets, which may include light autos, big trucks, specialized vehicles, and motorbikes. It includes a wide range of tasks such as vehicle purchase and financing, vehicle maintenance, telemetric (tracking and diagnostics) vehicles, driver and staff management, speed and fuel management, and health and safety management.

III. RELATED WORKS

The choice of approaches, technologies, and paradigms used to develop this study was informed by the review of related literatures. In order to contextualize our work, we briefly discuss the main algorithmic paradigms here and how they have evolved as a result of new design paradigms, data structure innovations, and input limits.

[1] Have created a method to locate basic public utilities such as ATMs, fuel stations, public parks, and other locations around a city using the shortest path utilizing GPS and Map Service. Additionally, the built application that is compatible with Web Services and mobile devices running the Android OS. While they did not provide a solution for a real-time updated map, it has also been mentioned that techniques like the Optimum A* algorithm have been utilized to discover the shortest path.

In the study, a cost-effective decentralized vehicle remote positioning and tracking system Using BeiDou Navigation Satellite System and Mobile Network [2]. The results of the experiments demonstrate that the system is capable of at a reasonable cost, tracking the location of a car and alerting the owner if the vehicle unexpectedly moves more than 100 meters is possible. The system is able to exploit maximum vendor neutrality and high availability due to the design concept of maximum vendor neutrality and high availability. Numerous navigation satellite systems and mobile networks are available. Following testing, it was determined that when the car departed from its original parking place 100m, the system could dynamically display the vehicle's location at the specified time, and then transmitted the voice alarm information at the specified time. Key gaps from the study are that the study is based on

GSM network capacity. Ant failure in the network signal of the GSM jeopardize the result.

Nassir SallomKadhim et al carried-out research titled “An Efficient Route Selection based on AODV Algorithm for VANET” using a GPS and GSM module, to track the location of the vehicle and provide an effective route in the event of an accident. With the aid of wireless networking carried by the node (auto) and GPS position from satellite, there is a vehicle tracking system that has been employed by local emergency services. The wireless network (VANET) utilizes a router with a vehicle and provides location-based data to the closest Road Side Unit (RSU), which then transfers that particular data to the internet for access by agencies through their built-in electronic map system.The agencies are able to see the exact location of the vehicle whenever an accident occurs, and they can use GSM to send an SMS to the closest ambulance services. Additionally, the algorithm used in the digital map determines the most effective (short path with little traffic) path for caring for patients. VANET's Routing protocol greatly facilitates cooperation for this system (Position based, Broadcast based, Topology based, Geo cast and cluster based). For pathfinding tasks, they have proposed the "VANET routing protocol algorithm (RASS-AODV)" method.

Guddi Singh et al work on an emergency moving vehicle system called “Movement of Emergency Vehicles - Using Shortest Path Simulation Method”.They built this technology for emergency services such as fire departments and ambulances. In the event of an accident or a fire, these vehicles can reach the location in a timely way by using the shortest route. All accessible information on emergency vehicles in town, as well as other pertinent information such as hospitals and police stations, is maintained in their database.In this system, traffic control signals are maintained in a database, and a modem is used to control a GSM server. The operator of the main server can track the whereabouts of the emergency vehicle. If the operator receives any emergency information, he or she may utilize the available car to reach the designated place using Google Maps. GSM module was utilized to locate the location and local hospital.Intelligent Transport System is maintained to regulate traffic lights in order to reach emergency vehicles in a timely and quick way using GPS, GSM, and Google traffic API. To employ short path, they used Dijkstra's method, which uses a network to identify the shortest path. It keeps track of a source node and finds the shortest path from that source node.

IV. METHODOLOGY

Based on the concerns highlighted beforehand, this application will be a program that will assist peoplein obtaining information about the location of the nearest facility from the user's position. Applications are designed to operate on both web and mobile phones. The location of the search facilities will be provided by this application. This program not only shows the position of the nearby site that you are looking for, but it also provides some basic information such as the name and address for this sort of facility.The application will also give extra information on the path that the user can take from their starting point to their destination.

There are two types of apps created: application servers and mobile applications. A web server is a server application. Mobile apps are applications that are used on Android-based mobile phones. The user system has requested input on the location, type of amenities desired, and public transit routes.

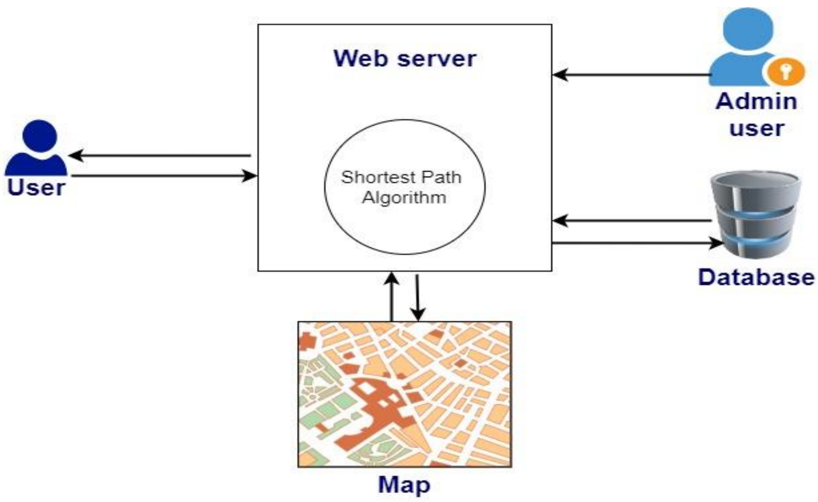

Fig. 1: Implementation

A. *Application server*

The application server is at the heart of all the processes that take place in this application. The application server is constructed on a web server and may be accessible at any time as long as the user has access to the internet. The application server will look through a list of locations to find the closest facility to the user's request. Processes that occur in the server include collecting input from user mobile applications, locating nearby public facilities.

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B. Mobile Application

A mobile application is one that allows users to request information and then shows the results. This mobile application will be developed on an Android-based phone. A process that occurs in the mobile application includes the process of inputting input, the process of acquiring user location, the delivery request, and the admissions process, as well as the display of information from the application server.

The user uses a mobile phone to look for the nearest location request using mobile apps. The process that occurs in the mobile application involves the user's request, the process of submitting the request, and the presentation of the information's outcomes. Processes user requests are used to enter user data such as location and kind of amenities sought. The procedure of making a request for information desired by users. The process of showing information is divided into two parts: the process of displaying the outcomes and the process maps.The results presentation procedure is used to display the detailed information of search results. The method of obtaining maps includes route maps that may be utilized to reach the desired place.

C. Web Application

A web-based software application will be used for the vehicle routing plan system, this is necessary for many reasons. A Web application (Web app) is an application program that is hosted remotely via a server and deliver services via the internet through a browser interface. A web application is usually a client-server program, what that means is that it has a client-side interface and a server-side which usually interface with the server at the backend. Client refers to the program that the individual uses to manipulate or operate the application. It is part of the client-server environment, where many computers share information. For example, in the case of a database, the client is the program through which the user enters data.

V. SHORTEST PATH PROBLEM

What is the shortest route between a source vertex and another vertex in a graph with edges labeled with weights or distances? Shortest-paths difficulties are problems that call on us to provide answers to these kinds of questions. Shortest-paths issues emerge in a variety of forms.If the goal of a single-source shortest path problem is to identify the routes that connect a given source to all other vertices, a single-pair shortest path problem is to identify the routes that connect a given source to a given destination vertex, and an all-pairs shortest path problem is to identify the routes that connect all pairs of vertices.

In this article, we take into account the single-source shortest-paths problem and use Dijkstra's techniques to address this issue. While Dijkstra's approach is more effective than other weighted algorithms in determining the shortest path, it is mostly sequential and is limited to graphs with non-negative edge weights.If a weighted directed graph G = (V, E) be a weighted graph with weight function w: E → R mapping edges to read valued weight. If ε = (u, υ), we rewrite *w*(u, υ) for w(ε).

The length of a path p = [υ_0, υ_1, υ_2, $\upsilon_3 \ldots \upsilon_k$] is the sum of the weights of its constituent edges:

Length (p) =

$$\sum_{i=1}^{k} w(v_i - 1, v_i)$$

The distance from u to υ, denoted δ(u,υ), is the length of the minimum length path if there is a path from u, to υ; and is ∞otherwise.

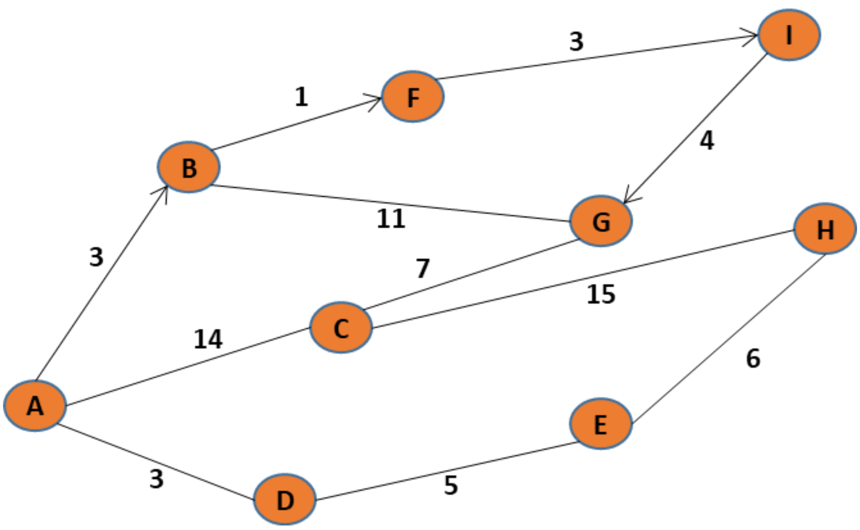

Fig. 1: Graph of Multiple Route

From figure 1, the route and sum of the shortest distance from A to G is A, B, F, I and G, and the weight of that route is 11.

A. Dijkstra's Algorithm

The Dijkstra algorithm is a method for solving single shortest path issues with positive weighted values. The objective of Dijkstra's algorithm is to identify the route between two points that has the minimum weight. Assuming that a point is used to represent a location and a line to represent a path, the Dijkstra algorithm computes all possible minimum weights for each point.One of the most well-known methods for solving the shortest path problems is the Dijkstra algorithm, although it can only be applied to networks with positive edge values.It is possible to modify Dijkstra's algorithm for finding the shortest paths in a variety of ways. One such approach is the Modified Dijkstra Shortest Path(MDSP), a fresh approach that yields successful results in discovering the shortest path.

The main idea of Dijkstra's algorithm is maintain an estimated d[ʋ] of length δ(s, ʋ) of the shortest path for each vertex ʋ. Always d[ʋ] ≥ δ(s, ʋ) and d[ʋ] is generally equal to the length of a known path d[ʋ] = ∞ if there is no paths for it.

Initially d[s] = 0 and all the other d[ʋ] values are set to ∞. The algorithm will then be processed in the vertices one after another is a specific order. The processed vertex's estimate will be validated as being real shortest distance, d[ʋ] = δ(s, ʋ). Below is the implementation of Dijkstra algorithm,

AlgorithmDijkstraSP(G, v):

Input: A simple undirected graph G with nonnegative edge weights, and a distinguished vertex v of G

Output: A label, d[ʋ], for each vertex u of G, such that d[ʋ] is the distance from v to ʋ in G.

d[ʋ] ← 0

for each vertex ʋ≠ v of G **do**

d[ʋ] ← +∞

let priority queue, Q, contain all the vertices of G using the D labels as keys.

while Q is not empty **do**

//pull a new vertex ʋ into the cloud

ʋ←Q.removeMin()

for each vertex z adjacent to ʋ such that z in in Q **do**

//perform the relaxation on each edge (ʋ, z)

Ifd[ʋ] + w(ʋ, z) <d[z] **then**

d[z] ← d[z] + w(ʋ, z)

change the key for vertex z in Q[z]

return the label d[ʋ] for each vertex ʋ

VI. CONCLUSION

In this research, we examined the most significant vehicle routing approaches that have been discussed in previous implemented to find the most efficient paths.Additionally, we included fresh measures and inputs that those algorithms may employ to perform better in road networks. Additionally, the evaluation criteria for these algorithms' performance are highlighted. We also provided a framework for updating the optimum route while a vehicle is traveling.

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