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COLLABORATIVE LOGISTICS PLATFORM: AN ANDROID-BASED SOLUTION FOR COST-EFFECTIVE AND ECO-FRIENDLY GOODS TRANSPORTATION

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ABSTRACT

This paper describes a holistic strategy for the design and realization of an open logistics platform that supports low cost, low emissions transport for medium to heavy freight. The Android application integrates geolocation & tracking systems, machine learning for fare computation and route optimization algorithms to permit multiple users to share vehicle space for urban & intercity good transportation. Its proprietary algorithm calculates fare according to distance flown, weight, and volume for optimized use of space as well a reduction in pollution by combining orders on the same journey. This research distinguishes the system architecture, technologies and algorithms employed to construct a platform that addresses the requirements of sustainable urban logistics

Keywords: Collaborative Logistics, Sustainable Transport, Shared Transportation, Geolocation And Tracking, Route Optimization, Cost Optimization.

I. INTRODUCTION

The logistics sector is grappling with a slew of critical challenges such as rising transportation costs, booming demand for convenient delivery systems and urgent requirement to adopt sustainable practices. This paper details the methodical design of an open logistics platform that answers these questions related to medium-to-heavy freight transport.

This Android application applies these new machine learning algorithms to advance features such as geolocation and tracking systems for fares and route optimization. This platform is designed to help lower costs and emissions by allowing multiple users to use space in a vehicle for urban and intercity goods transportation. Fares are calculated by a proprietary algorithm that factors in distance, weight, and volume to maximize space utilization while reducing environmental impact through consolidation of orders on shared journeys.

II. LITRATURE REVIEW

Many logistics platforms, including Uber, Ola, and BlaBla Car, exist mainly in the segments of transporting passengers and individual ride transportation. Even though their algorithms are quite advanced to optimize routes and calculate fares, no one is particularly suited for peer-to-peer collaborative transport of medium to heavy goods.

Porter: Porter is another player in the logistics space, specific to goods transport. It does not have a shared model, which minimizes its ability to provide spacings and costs' optimization for multiple users with converging needs for deliveries.

Research work on optimizing algorithms for logistics has largely restricted it to one-user scenarios, nearly entirely ignoring the benefits of collaborative logistics. This has been one of the areas that needed solutions, with a solution lying in the ability to have several users share space in a vehicle-an area huge on efficiency improvement, cutting costs, and environmental impacts.

Our project is thus targeted to fill this gap by producing a shared transportation goods provision platform. This is to be achieved through integration into a geolocation-based tracking system, which incorporates the power of machine learning algorithms, in order to provide an efficient and an eco-friendly urban and intercity freight transport solution.

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III. METHODOLOGY

3.1 Research Design:

This research project will be on an open logistics platform that supports the efficient and sustainable transport of medium to heavy freight. These designs will especially involve some key elements:

3.1.1 Data Collection:

This research project will be on an open logistics platform that supports the efficient and sustainable transport of medium to heavy freight. These designs will especially involve some key elements:

- Distance: The distance between the pickup and delivery locations (coordinates), which will influence the fare.
- Volume: the space occupied by the goods, calculated by multiplying their size in length breadth, and height (in meter), and is requisite in estimating transportation costs.
- Weight: this also ensures that the weight content does not overflow in the vehicle.
- Demand analysis: The high demand areas based on historical data coupled with the specific time of the day in order to optimize routes and price volumes.
- Delivery Timing: The estimated time required to complete the delivery, which will be considered for evaluating potential surcharges during busy periods.

Table1: Sample Dataset for Price Calculation

Delivery ID	Pickup DateTime	Pickup Latitude	Pickup Longitude	Dropoff Latitude	Dropoff Longitude	Volume	Weight	Demand Area	price
1.	2024-10-01 13:30:00	18.5203	73.8567	25.5940	85.1376	2.3	3	high	200
2.	2024-10-01 13:30:00	28.6100	77.2300	19.0761	72.8775	2.34	1.2	low	250
3.	2024-11-01 12:30:00	12.9789	77.5917	18.5203	73.8567	0.2	1.1	high	120
4.	2024-10-01 15:15:00	19.0761	72.8775	26.8500	80.9500	10.34	4.3	medium	

3.1.2 The project will also feature the aspect of providing insurance based on the value being transported into enabling users to have that extra layer of protection.

3.1.3 Rating System from the User and Driver End- A rating system will be incorporated by which the user will be able to rate a driver and vice versa, which will ensure accountability and improve the service quality.

3.2 Algorithm:

3.2.1. Bin Fitting Algorithm for Volume:

The Bin Fitting Algorithm efficiently allocates items into available space based on their volumes. Determine whether item fits in available space or not.

3.2.3 Gradient Boosting for Fare Calculation:

Our application exploits the power of gradient boosting, which involves the machine learning algorithm that combines several weak models to form an incredibly powerful predictive model. Trained over a dataset that contains historical fare data, with this model, the Gradient Boosting function is able to significantly capture the underlying relationships involving factors such as distance, weight, volume, demand area, and time of delivery, thus building up to have effective predictions of new transportation requests' fares.

3.2.4 Dijkstra's Algorithm for Shortest refence Path:

Dijkstra's Algorithm will, therefore, give the shortest possible path between two points which also ensures that the route taken by a driver is efficient.

It would help us to take this reference path as the reference line through which we could identify any pickup and drop-off points that fall within an acceptable distance or range, such as 10 km, from the path.

3.2.5 Using Mapping APIs for Shortest Path Calculations:

This is made possible due to the fact that with algorithms embedded within map APIs, such as Google Maps, Mapbox, or OpenStreetMap, we can find the shortest path from a point to the closest road segment, making way for an efficient verification of whether a point is acceptable for pickup or drop-off, based on proximity to accessible roads.

3.2.5 Traveling Salesman Problem (TSP):

The Traveling Salesman Problem (TSP) algorithm will be utilized to determine the most efficient route for the driver, covering all pickup and drop-off points while minimizing travel distance and time. By optimizing the sequence in which these locations are visited, the TSP algorithm helps reduce fuel consumption and enhances overall delivery efficiency. This approach not only saves costs but also contributes to reducing the carbon footprint of transportation. Implementing TSP allows our logistics platform to provide drivers with a practical and optimized route, improving user satisfaction and operational effectiveness.

IV. APPROACH

Implementation:

Step1: The driver creates a ride by specifying its start (source) and end (destination) points. Then the shortest path is created between these two points which becomes a reference path. This route is only used as a guide for identifying possible pick-up and drop-off locations along the way. The driver is at liberty to follow not the expected route, if need be.

Figure 1: Reference path between source and Destination.

Step2: Users search for available vehicles by specifying their desired pickup and delivery locations. The system identifies vehicles based on the reference path created in Step 1. Users will only see vehicles where both the pickup and delivery locations are within 10 km of the reference path. This helps to ensure the selected points are close enough to the driver's planned route, minimizing detours.

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Figure 2: Accepted Coordinates within 10km from reference path.

Step3: After all of the users have scheduled their couriers, it then calculates a new route for the driver. This route will cover all the pickup and delivery points while minimizing total distance travelled and time. The driver is given the most efficient way to cover all locations in the route, therefore minimizing costs and environmental impact input.

Figure 3: Created new route covering each pickup and delivery points.

V. CONCLUSION

Our logistics platform uses cutting-edge technology to streamline the movement of goods, making it more economical and environmentally sustainable. Through the integration of machine learning, geolocation, and route optimization, we aim to create a harmonious experience for users and drivers. One of the key features of the platform is the use of machine learning algorithms to determine the right price based on factors such as distance, weight, and volume. This ensures that the price is transparent and fair, allowing users to make decisions based on their shipping needs. The pricing platform also provides a dynamic pricing model that adapts to real-time data and adjusts based on demand and other factors. When drivers post their trips, the system calculates the best usage from the starting point to the destination. This method is not mandatory for drivers, but it is important for determining passenger pick-up and drop-off points. By allowing pick-up and delivery only within 10 kilometers of the reference route (which is in between source and Destination fig no.1), we make this efficient and reduce travel time, saving time and reducing fuel consumption. When each user books a delivery service, an optimal route is created for the driver that covers all selected destinations and departs from the shortest route. This approach helps reduce costs, travel time and environmental impact. This transparency not only builds trust, but also increases customer satisfaction by informing users about the status and estimated time of arrival of their shipments. We aim to improve the logistics experience and provide peace of mind to users by providing real-time tracking. By encouraging car sharing, we reduce the number of trips required to transport goods, thereby reducing emissions and carbon footprint. This integrated model also maximizes the use of vehicle space, providing a great solution for occasional and frequent users. As cities expand and the need for efficient, sustainable transportation solutions continues to grow, our platform is well positioned to address these challenges by offering flexible and innovative solutions for urban logistics. The platform aims to revolutionize the logistics industry by combining electronic technology with a functional environment. It offers large-scale solutions to the needs of modern cities, enabling a wide range of uses from individuals to businesses. With our platform, we are developing the path to a more efficient and profitable future in transportation.

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