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A Modified Ant Algorithm Integrates Real-Life Road Constraints in Vehicle Routing Under Uncertain Environments: a Case Study of E-Commerce Courier Companies in India.

Krishnendu Mondal and Sandeep Mondal

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A Modified Ant Algorithm Integrates Real-life Road Constraints in Vehicle Routing under Uncertain Environments: A Case Study of e-commerce courier companies in India.

Krishnendu Mondal[a], **Sandeep Mondal**[a]

a *Department of Management Studies, Indian Institute of Technology (Indian School of Mines), Dhanbad, India*

ABSTRACT

India is one of the highly populated countries in the world where almost 390 peoples are residing per square kilometer and out of which 28% of the total population is using an online shopping platform for their necessities. To maintain the supply chain from warehouse to customer's location is a tough job in a country like India where unpredictable changes can happen any time irrespective of the moving vehicle, which is on the way from the warehouse to the destinations. The supply chain network that is followed by the online retailer companies or the stores that offer e-commerce facilities, is so designed that it primarily caters to successfully meeting the requirements of the customers. The recent advancements in technology and rising demand indicates the need for a complex decision support framework which has directed the e-Commerce and third-party logistics industries to an extremely competitive environment. This paper focuses on vehicle routing problems which are basically region-based and delivers mostly any types of food products. There are products in the delivery vehicle which has less shelf life than others and those products have to be delivered within their allocated time to avoid deterioration. Most of the delays in deliveries have been observed due to the ambiguous requests received from the customers. These dynamic requests may arrive at any point in time and it is irrespective of the vehicle's position, whether it is at the warehouse or on its way. This uncertainty causes an interruption in the existing vehicle route which leads to an upsurge in greenhouse emissions. The Ant System algorithm has been reformed according to specific constraints like the size of the roads and traffic congestion factors to optimize the vehicle route. The objective of this study is to minimize the emission caused by the movement of vehicles in transportation while satisfying public needs and demand.

Keywords: Dynamic Vehicle Routing; Ant System; Online food retailers

1. Introduction

The evolution of the Indian industries has been triggered by the expansion of the internet of things. This digital revolution may increase the Country's internet user base to 0.8 Billion from 0.5 Billion by 2022. It has transformed the way of living where shopping style is mostly affected by the development of internet and communication technologies (ICT) (Byung Duk Song et al. 2016). Nowadays Communication in business as well as in personal affairs has been facilitated by the development of Information Technology and consequently leads to the striking growth of goods being shipped across areas or countries (Canhong Lin et al. 2014). Peoples are craving for fast deliveries and quality products at a cheap price. The e-commerce services are provided by express companies (e.g. DHL, Federal Express) to fulfill the requirements of the peoples, to maintain a good position in the industry, to get more customers and sustain a high level of service. But at the same time, there is also a need to focus on our environment. Environmental and ecological effects are taken into consideration when designing logistics policies. To transport the products to their

respective locations within the given time, a violation of the environment policies may happen. Because in real-life applications where parameters such as customer demands, travel and service times or even the information of whether a particular customer will require service or not, vehicle could be able to pass through a particular road or not, which road is less congested at any particular time are often incomplete, uncertain, or unknown during the route design phase. The available information is subject to change even after the routing plan is executed. This dynamicity is only referred to that immediate requests which are revealed over the time during the execution of the routing process. This literature is concerning the cancelations of orders at any time which may disrupt the routing plan significantly. A modified AS algorithm is used in this study to obtain a dynamic network by considering all the constraints. The aim of this paper is to minimize the vehicle tour by adjusting dynamic requests, real-time traffic congestion and load-bearing capacity of the arcs in the existing tour, which helps to reduce the emission and wastage of perishable products.

2. Literature Review

The vehicle routing problem (VRP) concerns physical distribution that involves the transport of goods from production sites to warehouses and from warehouses to customers discussed by Tsai et al. (2003). These problems are solved using two approaches: one is the exact approach and another is the approximate approach. Goss et al. (1989) have discovered the idea of finding the shortest route by using ACO. After a few years, Marco Dorigo and Thomas Stutzle (1991) proposed this meta-heuristic approach. They have used the science behind foraging behaviors of the ant colony to find an optimal way to cover all the nodes in the shortest distance.

3. Model Development and Analysis

The ant system algorithm has been modified accordingly as per the research problem where few area clustering algorithms have been introduced, which are primarily involved in grouping the destination locations as per the vehicle capacity and assign them with the particular vehicle. On the next phase, which road is capable of carrying a particular sized vehicle has been identified using a function which is linked with the basic probabilistic term of AS. Similarly traffic congestion of the roads are introduced in the pheromone update trail functions where the roads have been provided by a weightage for real-time traffic intensities. The more the congestion on the road, the more pheromone will evaporate from that road. To execute the best route, the ants have been sorted accordingly as per their best tour and the best ant has more weightage to deposit more pheromone on the route. These modifications have been supplemented in the base AS while execution of vehicle routing. The modified AS has been used to run in Matlab using three randomly generated locations sets Ran 120, Ran 80 & Ran 40 to perform the execution and analysis. The modified AS performs well in three of the locations sets.

4. Conclusions

This research problem deals with uncertainties in routing execution. It has been modified according to the problem statement. The modification in AS performs similar results as in base AS. In most of the instances, it gives a greater route than base AS because this algorithm avoids congested routes and concerns the capacity of the routes too. Total distance traveled may be increased using this algorithm but the traveling time or engine running hours is reduced which is directly related to emission.

5. References

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1. Krishnendu Mondal, Research Fellow, IIT (ISM), Dhanbad-826004, India, Email: krishnendu.ism.iem@gmail.com , Mobile- 8918287207.
2. Dr. Sandeep Mondal, Professor, IIT (ISM), Dhanbad-826004, Email: sandeepmondal@iitism.ac.in