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Dispatch Management System using VRP Algorithm for Job Scheduling

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ABSTRACT—Online vehicle routing issues take a lot of work to solve. However, several approaches have been successfully put forward. The solutions often focus on improving traditional metrics (such as the number of cars mobilized and the overall distance travelled). On the other hand, with online systems, improving the reaction time to connected users becomes at least as crucial as improving the conventional criteria. Multi-agent systems and greedy insertion heuristics are the most effective strategies to maximize this criterion.

For this reason, we suggest a multi-agent system and concentrate on the clients' dispatching method. The approach chooses which agents perform the computation to fulfil the client's requirements. We suggest using one of three dispatching methods: centralized, decentralized, or hybrid. Our comparison of these three strategies is based on how quickly they respond to internet consumers. This study investigates a vehicle routing and workforce scheduling issue involving technicians travelling by car to customers' locations to provide service. Stochastic occurrences impact travel and service schedules. Each service job has a set window within which it may begin. The possibility that a technician assigned to a job may arrive at the client location after the time window is known as the risk of missing

KEYWORDS— Lexical simplification, BERT, Unsupervised, Pretrained language model.

I. INTRODUCTION

Consumers now have more affordable options for products and services because to globalization. Additionally, it makes it harder for suppliers of products and services to maintain profitability in a more cutthroat economy. For service or product delivery businesses to succeed financially and have a solid reputation, they must fulfill client expectations and make scheduled visits. As a result, these businesses must constantly assess their operational effectiveness. When it comes to efficiency, allocating resources, including personnel, to activities to maximize certain criteria while taking operational limits into consideration is a typical difficulty for most organizations. It is vital to make sure that the resources on hand correspond to the anticipated workload. Numerous real-world distribution applications, including the delivery of goods to retailers, the routing of school buses, the distribution of newspapers and mail, etc., are instances of vehicle routing problems (VRP). A VRP is a traveling salesman problem with many vehicles in its original form. A number of nodes must be visited by a number of vehicles just once. Finding a set of routes for the vehicles that optimum both the number of mobilized vehicles and the overall distance traveled is usually the goal of the task. The practical value of solving these challenges is quite high, and they are difficult optimization problems with interesting concerns. One of the most researched variations of the vehicle routing problem with time windows, or VRPT, is the problem variant with time (and capacity) limitations.

II. LITERATURE REVIEW

According to [1] The logistics and transportation procedure are in order thanks to the GPS system. Through the GPS system, customers may get a real-time knowledge of the products in transit and estimates for when they will arrive at their destination. GPS may provide call conductor, security, anti-robbery, driving route tracking, and vehicle location. The three components of the GPS terminal, transmission network, and monitoring platform must be present in order to accomplish all of the aforementioned functions. The objective of an intelligent logistics management system is to provide big and medium-sized logistics companies with a set of practical, intelligent, and practical logistics solutions for quick response capabilities. The study presents a concept for an intelligent logistics management system based on GPS.

According to [2] an online graduate archive dispatching management system that introduces the system analysis and design process from the system modules, framework, and major technologies employed in this system. It concludes by

summarizing the ensuing lines of in-depth investigation and advancement..

According to [3] FSV DMS was developed using the C#.net platform and certain fundamental features were implemented. The applications are created using a component-based design approach to speed up software development and allow for reuse. The FSV DMS has been installed at a few Chinese airports and functions well. As a result of the inevitable AP roaming delay on our network, packages may be lost when a vehicle switches from one AP to another.

According to [4] a comparison of the two types of management strategies for battery energy storage (BES) facilities in island power systems with high RES penetration is performed. The island system operator may centrally command BES facilities placed to enable the integration of extra wind capacity, or they can self-dispatch inside a virtual power plant entity made up of renewables and storage, known as a Hybrid Power Station (HPS). Annual simulations are run for an example island system using a three-layer mixed integer linear programming (MILP) approach to replicate the unit commitment and economic dispatch processes in order to examine the predicted advantages of each BES management paradigm. In order to identify the Pareto optimal storage configurations that will result in the lowest levelized cost of energy (LCOE) for a specific RES penetration target, the levelized cost of energy (LCOE) of combined BES and renewables investments is calculated, and the achieved RES penetration levels and island system generation cost are evaluated. According to [5] Two divisional areas in Bangladesh's Dhaka and Khulna have been constructed with optimal hybrid off-grid renewable energy systems (HRES). Finding the most cost-effective and technically possible load dispatch approach for an Islanded hybrid microgrid that can sustain the rising power demand requires conducting an analysis utilizing five distinct load dispatch systems. To determine the best and worst dispatch methods for the suggested HRESs, a comparative study of the different dispatch strategies is also provided. The two HRESs have 23.31 kW of load demand, a wind turbine, solar PV, a backup diesel engine, and a battery storage system. The following dispatch strategies have been used for evaluation: HOMER predictive approach, Generator Order, Load Following, Combined Dispatch, and Cycle Charging dispatch method. On the basis of the five dispatch methodologies, the two HRES are optimized for CO₂ emission, Levelized Cost of Energy, and Net Present Cost reduction coupled with a workable and reliable voltage-frequency response. Using the HOMER Pro software platform, the techno-economic study of the two HRESs is performed.

According to [6] For improved flexibility and performance, a unique adaptive real-time scheduling mechanism for MAS is further developed. This approach overcomes the drawback of the conventional single dispatching rule method's subpar performance in MAS and fixes the issue that was previously converted. This method models the scheduling process as a contextual bandit, allowing each task agent to choose the best dispatching rules based on the current state of the environment after learning to achieve scheduling optimization.

According to [7] an ATC dispatching algorithm based on reinforcement learning that calculates the lookahead parameter from the job's raw data (processing time, weight, and slack time). Using the deep deterministic policy gradient (DDPG) approach, the scheduling agent interacts with the scheduling environment to understand the link between the raw task data and the continuous lookahead parameter. Through simulation of a single-machine scheduling issue with uneven task arrival times, we trained the DDPG model to reduce the TWT.

According to [8] A deep CNN is used to estimate the state-action value in a scheduling process using a disjunction graph. This process is considered as a multi-stage sequential decision-making issue. The network receives multi-channel pictures that represent the manufacturing states. As potential actions, many heuristic rules are used. The RL agent adopts the dueling double Deep Q-network with prioritized replay (DDDQNPR) and continuously experiments with the scheduling environment to find the optimal set of combined actions for each decision step. On 85 JSSP instances from the well-known OR-Library, static computational tests are carried out.

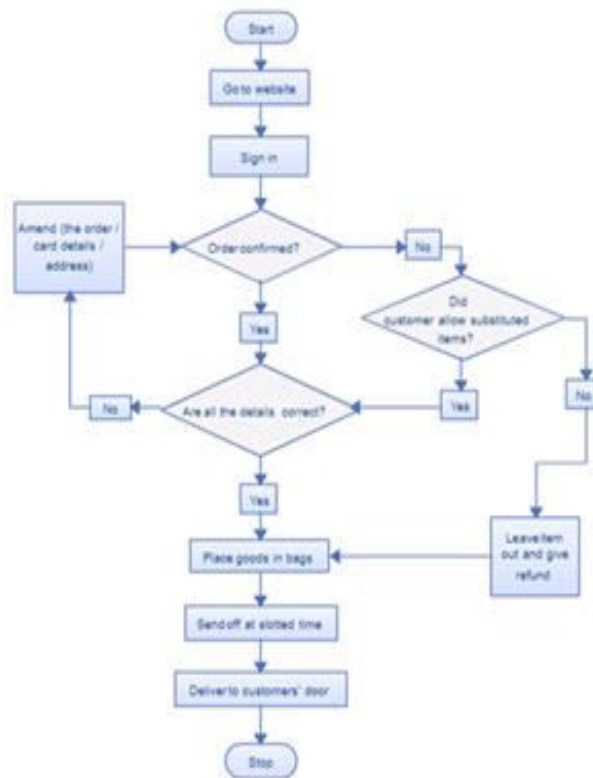
According to [9] task distribution in massive, diverse server clusters sharing resources with limited buffers. In today's huge data and communication systems like Amazon Web Services, Network Service Function Chains, and Stream Processing, this load balancing issue naturally develops. Following a load balancing strategy that maximizes a performance parameter like task completion time, arriving jobs are sent to a server. Our contribution is a Cost-Based Scheduling (CBS) strategy that is randomly chosen, with the work assignments determined by the general cost functions of the server queue lengths. The idea of CBS generates additional application-specific algorithms beyond current ones like the Join the Shortest Queue (JSQ), the power of d or the SQ(d), and the capacity-weighted JSQ. policies such as hybrid locally uniform JSQ.



According to [10] a method of solving the generation dispatch issue using an optimum generation scheduling strategy based on linear relaxation and mixed integer programming. Using the mixed integer programming method and linear relaxation, the quadratic transmission loss constraint of each transmission line is transformed into linear constraints. In order to make the original optimum generation scheduling issue amenable to being solved by a commercial optimization solver, it is phrased as a quadratic programming or mixed integer quadratic programming problem. This study further analyzes the generation scheduling model and eliminates unnecessary variables and restrictions in an effort to increase algorithm efficiency. To evaluate the efficacy of the suggested strategy, three test systems—the IEEE 30-node system, IEEE 118-node system, and Polish 2746-node system—are used.

III. METHODOLOGY

Using an architectural map of the large infrastructure. These maps include a top view of every floor containing different attributes of these infrastructures. These attributes can contain obstacles like walls, tables, partitions, chairs, separations of floors & sectors.



Framework of DMS

The framework of this system is composed by 5 kinds of modules. First, the basic information management module, as the module to manage cargo information and vehicle information that are necessary for dispatch planning, supports flexible planning and amendment/re-planning process. The pre-planning setting module supports the pre-constraint and parameter that should be considered to be reflexed to the planning. On the other hand, the planning module based on CSP and meta heuristic technique reduces the errors that can be occurred during the handworks, enhances the quality levels of the planning and supports planning result management.



Basic Information Management	Pre-planning	Planning	Revision/Modification
Cargo Information Size/Capacity.. Source of supply/demand..	Parameter setting	Algorithm CSP Meta-Heuristic	Rule based revision Manual based revision Saving alternatives
Vehicle Information Size/Capacity.. Depot..	Constraint setting	Result Management	Evaluation Alternatives evaluation (by cost, time..)
Transportation Information Time windows.. :	Definition or Selection of Pre-planning rules		

Motivation

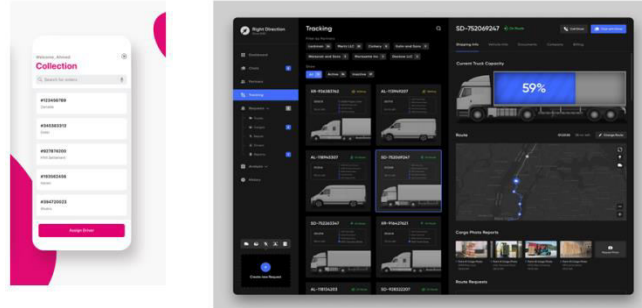
- Automatically assign a vehicle or an employee to a customer.
- Schedule appointments or deliveries.
- Optimize route schedules based on distance, priorities and deadlines.
- Provide daily task lists to drivers and employees.
- Control performed services.
- Manage customers, drivers, vehicles, carriers, and employees.
- Provide easy communication of call center reps with drivers or employees working in the field.
- Provide daily, weekly, monthly or quarterly reports/transactions.

Goals and Objectives

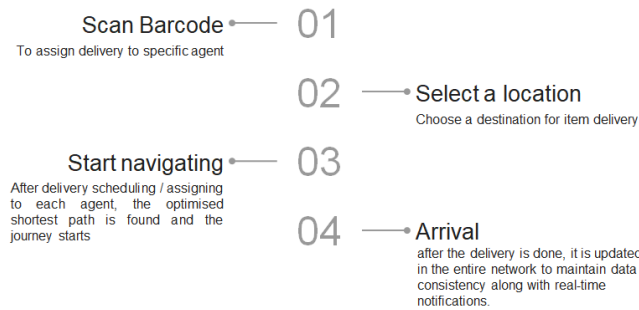
- Drivers can use the task assignment feature to automatically assign delivery jobs by scanning a parcel barcode or QR code.
- Route navigation decreases the likelihood of drivers wasting time on the road because they are unsure of the quickest route to each stop
- 48% of ecommerce customers across the world expect their deliveries to be quick, when customers receive their parcels on time or earlier, they are more likely to feel satisfied with the transaction, increasing brand loyalty.
- Still, despite the spiking fuel price in India from early 2022 to April 2022, which grew 15.90% from 104 INR per litre to 120 INR per litre, many businesses are brave enough to offer low-cost shipping.
- 78% of buyers would not use a retailer again after three late or incomplete deliveries.
- The delivery notifications feature simplifies notifying recipients by automatically sending out the shipping details



Mobile Interface



User flow



IV. ALGORITHMS

- Deflate Lossless Algorithm for real-time connection.
- Deflate algorithm is compared with other lossless algorithms, i.e. Huffman, LZ77 and LZW algorithms in order to find a suitable compression algorithm for WebSocket protocol for real time tracking of orders with minimal data flow compression algorithms is to be used.
- Deterministic linear programming model (DLP)
- A deterministic linear programming model (DLP) that uses either the rolling horizon or shrinking horizon technique in order to determine optimal re-order quantities for each time period at each node in the supply network. Customer demand is modeled at its expectation value throughout the rolling/shrinking horizon time window.
- Multi-stage stochastic program (MSSP)
- A multi-stage stochastic program (MSSP) with a simplified scenario tree, Shrinking and rolling horizon for the MSSP model are both implemented to decide the reorder quantity at each time period.
- Reinforcement Learning Model (RL)
- A reinforcement learning model (RL) that makes re-order decisions based on the current state of the entire network.

V. CONCLUSION

In this research, we concentrate on client dispatching algorithms and offer a multi-agent system with three variants. The agents that carry out the calculation to fulfill the client's requests are chosen by the dispatching strategy. The planner agent handles the majority of the calculation in the centralized approach. The vehicle agents collaborate to carry out the majority of the computing in the decentralized approach.

VI. FUTURE SCOPE

Multi-platform application to ensure efficient operations & analytics from a delivery side. Based on the collected data from the various constraints and site operation which have not been considered in the existing study, the method is



suggested for the development of the nationwide one-day integrative dispatch planning support system. This study promoted the practical utility by considering the constraints such as vehicle and capacity, amounts load regulations etc and the priority of transportation in the site operation. Nevertheless, it is suggested that it is necessary to undergo the study which includes IT-based real-time vehicle and cargo monitoring function such as RFID and GPS etc in order to support more appropriate and rapid decision making than this system.

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