DESIGN AN ALGORITHM FOR THE TASK ALLOCATION OF A FLEET OF AUTONOMOUS VEHICLES

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ABSTRAC: The project aims to design an algorithm for the task allocation of a fleet of autonomous vehicles within a company. The aim is to optimize routes and reduce transport costs by efficiently allocating loads between vehicles. In recent decades, computer applications have become indispensable in industry, providing solutions for streamlining processes and increasing productivity, and the designed algorithm will bring benefits both for performance improvement and cost reduction benefits to the delivery process. The paper will present both the design process and the development process of a software application for the task allocation of a fleet of autonomous vehicles.

KEYWORDS: "software", "algorithm", "efficiency"

1. Introduction

The transportation industry is in a time of change, and autonomous vehicles are considered to be one of the most important innovations in this field. One advantage of autonomous vehicles is transport efficiency. They can be programmed to follow the most efficient routes, avoid traffic and operate in the most efficient way possible. Autonomous vehicles can also be programmed to operate continuously, without rest or meal breaks, which could lead to a significant reduction in transport costs.

In recent decades, IT applications have become indispensable in industry, providing solutions to streamline processes and increase productivity. The industrial transport industry is one of the key sectors of the global economy, responsible for delivering goods and materials from one place to another using a variety of means of transport, including trucks, trains, ships and planes. In recent decades, the application of information technology in industrial transport has significantly improved the efficiency and safety of transport operations.

Key technologies used in the Industrial Transportation Industry include:

- Vehicle Tracking Systems (VTS)[1] - These systems use GPS and GSM technology to track the location and status of vehicles in real time. VTS are useful for improving the efficiency and safety of transport operations, as well as monitoring driver behaviour.

- Internet of Things (IoT)[2] - IoT technology allows smart devices to connect to the internet to collect and analyse data. In the transport industry, IoT can be used to monitor the condition of vehicles and trailers, optimise routes and reduce downtime.

- Fleet Management Systems (FMS)[3] - These systems allow fleet managers to monitor vehicle and driver performance, plan maintenance and repairs, and optimise resource utilisation. FMSs can help reduce costs and improve the safety and efficiency of transport operations.

- Artificial Intelligence[4] - AI technology can be used in industrial transport to analyse data collected from vehicles and provide real-time suggestions and decisions. AI can also be used to improve planning and scheduling, prevent unexpected breakdowns and reduce fuel costs.

Although autonomous vehicles are a fairly new thing introduced in the transportation industry, we can give examples of systems already existing in the industry for assigning tasks to vehicles, such as:

- Waymo Fleet Management System
- Aurora Driver Fleet
- Tesla Fleet Management

These systems offer a wide range of features and options to help operators efficiently manage their autonomous vehicle fleet, such as:

- Real-time monitoring of vehicle position and status,
- route scheduling and optimisation,
- energy management and vehicle maintenance.

One of the key aspects of these systems is the ability to optimise vehicle routes in real time so as to avoid traffic congestion and reach their destination as quickly as possible. Their artificial intelligence algorithms take into account information such as weather conditions, traffic and transport schedules to decide the best route for each vehicle in the fleet.

In terms of transportation technology, Waymo Via (a subdivision of Waymo) has developed a hardware and software platform that allows autonomous vehicles to safely navigate through urban traffic and deliver goods to their destination.

The platform is equipped with:

- Advanced sensors,
- cameras, radar and LIDAR,

These allow autonomous vehicles to detect and avoid obstacles in traffic and interact with pedestrians and other vehicles around them.

The platform also includes a navigation and mapping system, which allows autonomous vehicles to orient themselves in space and find the best travel routes.App concept

In this step, a web page was created using the programming languages HTML, CSS and JavaScript, which measures the reaction time from when the visual stimulus is displayed until the response is received. Each time the subject clicks, the web page will change its state.

When the web page is launched, it will display the first status, which contains the name of the application and its operating instructions.

2. Current status

The project focuses on the development of an algorithm for load allocation in a fleet of autonomous vehicles, with the aim of optimizing routes and reducing transport costs.

This algorithm will take into account several factors such as:

- Travel distance;
- vehicle battery capacities.
- kW/h consumption on routes

The algorithm will be tested through simulations with different scenarios (2 different load tonnages and 2 different routes). The results obtained will be used to improve the performance of the algorithm and to help transport companies optimise processes and save money by implementing an intelligent load allocation system in autonomous vehicle fleets.

Also, through the algorithm created, depending on the remaining battery level of the vehicle, it will be able to go to one of the charging stations offered on the company's premises, or make a next trip.

In order to better start the algorithm thinking process, we first need to understand the requirements and restrictions of the project. From my point of view, the load allocation algorithm for a fleet of autonomous vehicles had to consider the following aspects:

- available loads
- available vehicles
- the time required to complete each task
- location of vehicles and tasks
- battery charging time
- vehicle battery range

a. What are the tasks to be assigned?

The main task is to transport goods or packages from one hub to another.

b. What vehicles are available and what is their capacity?

It is important to know how many vehicles are available and the capacity of each in order to make an efficient allocation of tasks.

c. What is the estimated time required to complete each task?

This may vary depending on the distance between the vehicle location and the task.

d. Where are the vehicles and tasks to be assigned?

It is important to know the exact location of each task and vehicle in order to make an efficient task allocation.

e. What is the battery charging time?

It is important to know the time when the battery reaches a capacity that ensures that the vehicle can carry out the task to completion.

f. What is the vehicle battery range?

Knowing the vehicle battery autonomy is important in this algorithm to ensure that vehicles can reach the pick-up and delivery hubs.

Once we establish this information, we can start developing a task allocation algorithm.

At the moment, the project is still in its early stages, i.e. we need to determine the length of the routes, the weight of the loads, the battery capacity (kW/h) and the optimal battery charging time.

However, I can give an example of a potential algorithm that I would like to see in the final application.

- Identify the loads to be allocated and the available vehicles.
- Evaluate each load to determine weight, dimensions and distance between pickup and delivery hubs.
- Evaluate each available vehicle to determine maximum load capacity and maximum distance it can travel.

- Evaluate the battery autonomy of each vehicle

- Allocate loads to available vehicles based on load capacity, distance and time required to reach pick-up and delivery hubs.

- Update the vehicle route to include all assigned pick-up and delivery hubs.

- Monitoring the vehicle route to ensure each package is delivered on time.

- If problems occur, such as a delay or technical issue with a vehicle, the algorithm can reassign tasks to other vehicles to minimize the impact on scheduling.

3. Conclusions

By developing an intelligent algorithm that can optimise routes and reduce transport costs by efficiently allocating loads between vehicles, this project will provide an innovative and useful solution for transport companies. One of the most important aspects of this project is the use of a test dataset and the simulation of different load allocation scenarios.

This approach will allow to obtain good results and to optimise the algorithm to improve its performance in the future. The project will also contribute to increasing the efficiency and cost-effectiveness of transport processes by implementing an intelligent load allocation system in autonomous vehicle fleets.

4. References

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