Chapter I

Introduction

1.1 Background

The logistics sector is one of the sectors impacted by the development of Industry 4.0. As an integral part of the flow of raw materials and finished products from production to the end consumer, warehousing plays a crucial role in enhancing the competitive advantage of logistics and distribution service providers. Therefore, warehousing is considered a key source in achieving these objectives.[11]

Artificial Intelligence (AI) provides the ability for autonomous driving, commonly called autonomous vehicles, which can significantly impact the transportation industry by enhancing overall safety and productivity [2]. For example, Amazon.com has successfully implemented automation in the retail sector. Since acquiring Kiva Systems in 2012, Amazon has invested in technology to improve the efficiency of its distribution and customer services. Amazon has also introduced programs to assist employees affected by automation. The success of Amazon.com in implementing automation is reflected in a 359% revenue growth and an 800% increase in employees since 2012 [7].

Based on this data, implementing autonomous vehicles positively impacts efficiency in enhancing distribution services. By incorporating ride-sharing in autonomous cars, a reduction in operational costs can be achieved [8, 15].

Path planning is one of many important factors in ride-sharing. It is also crucial in several applications, such as logistics and delivery services [9, 6]. Therefore, in the ride-sharing context, it's essential to determine the optimal routes for multiple points.

Several algorithms, such as A*, Dijkstra, D*, and IDA*, can determine the best route. Based on relevant studies, "Route Recommendation Simulation for Ride-Sharing Autonomous Vehicle: A Comparative Study of A* and Dijkstra Algorithm" and "Dijkstra's and A-Star in Finding the Shortest Path: a Tutorial," the results of these studies indicate that A* provides more optimal performance compared to Dijkstra. In the related research on IDA*, IDA* works effectively in resolving the space growth caused by the A* algorithm [5]. The approach involves setting a maximum depth limit at each iteration and increasing this depth limit if the search in the previous iteration does not reach the target state. An evaluation function stops the search on a particular path when the value of f(n) exceeds the set depth limit [5, 16].

Currently, there is no research comparing the performance of A* and IDA* in implementing the search for the best route in ride-sharing AV. Therefore, this study aims to compare the performance of A* and IDA* in determining the best route for ride-sharing autonomous vehicles in a warehouse environment. This research focuses on evaluating both algorithms based on three measurement variables such as (1)total processing time, (2)memory usage, and (3)total distance traveled. The results of this study are expected to provide recommendations for the best algorithm in determining the optimal route implemented in ride-sharing AV in warehouse settings.

1.2 Problem Formulation

Based on the background that has been previously discussed, the following is the formulation of the problem:

1. How to conduct an evaluation of the performance comparison between A* and IDA* in determining the best route implemented in ride-sharing AV in a warehouse environment using a simulation approach with Python programming?

2. What are the results of the performance comparison evaluation between A* and IDA* in determining the best route implemented in ride-sharing AV?

1.3 Goals

The objectives that the researcher aims to achieve in writing this research are as follows:

1. Comparing the performance of the A* and IDA* algorithms in finding the best route implemented in ride-sharing AV in a warehouse environment.

2. To determine the performance of the A* and IDA* algorithms in finding the best route in the implementation of ride-sharing AV.

3. Implementing the A* and IDA* algorithms to determine the best route in the implementation of ride-sharing AV on autonomous vehicles in a warehouse environment.

1.4 Scope of the Problem

The problem limitations that need to be considered in this research are as follows:

1. This research will only discuss the use of the A* and IDA* algorithms in the implementation of ride-sharing routes in warehouses;

2. This research will only consider ride-sharing for the pickup and delivery of goods from the starting point to the destination;

3. This research will only use data and information obtained solely from simulations, without involving the use of real data or field testing;

4. This research limits the simulation to the scope of the Python matrix.