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Workshop AGV path planning and design

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Abstract: First of all, this paper presents the research background, generally introduces the development history of AGV and the current application status at home and abroad, analyzes the structure of AGV and the key technologies for AGV implementation, and has a deep understanding of AGV; The study of planning status and path planning algorithms, based on the modeling of AGV working environment, Dijkstra algorithm is used to plan the path of single AGV and the optimization method is combined with the actual situation. Finally, on the issue of multiple AGV implementation, the single Based on the research of AGV path planning, the Dijkstra algorithm and the time window method are further combined to solve the multi-AGV collision avoidance problem, so as to realize multi-AGV path planning.

Keywords: AGV, path planning, Dijkstra algorithm, optimization, time window method.

1. Introduction

Social production will not stop, there will be logistics if there is production. Early management scientists continuously squeezed workers to increase surplus value through means of division of labor and work specialization. However, time has proven that this method has very limited improvement in corporate efficiency. Increasing corporate efficiency has become a bottleneck restricting corporate development. Turning his attention to the field of production logistics, some materials show that in the composition of total production costs, handling, loading and unloading, storage and other links account for 20 to 50%. Logistics has a huge role in reducing the total production cost. Ten years have confirmed this, and AGV plays an important role in the logistics field of all walks of life. As far as the HD companies studied in this article, the introduction of AGV

It plays an active role in improving the production efficiency of enterprises and reducing production costs. The problem of path planning is one of the problems that must be solved by the introduction of AGV. Path planning will directly affect the reasonable operation of AGV, the safety of personnel and equipment, and the level of logistics efficiency. At present, many scholars at home and abroad conduct research on path planning through different algorithms. Simulation and quotation. On the basis of predecessors, this paper chooses an appropriate algorithm to plan the AGV path, which has a positive effect and significance for the effective use of enterprise AGV.

2. HD Company Profile

HD is now a company engaged in the production and maintenance of professional machinery and equipment in the coal industry. The company was originally established in the 1970s. With the continuous progress of our society, in order to adapt to the complex and changing external environment, the company has experienced many changes since its establishment. In the process of change, the company has continued to develop and develop. The company has registered capital of 20 million, covers an area of 52,000 square meters, and has a total number of more than 340 employees, including 10 senior management, more than 60 professional and technical personnel, and more than 200 front-line workers. The company has production workshops for mechanical parts processing, steel casting, electromechanical equipment manufacturing and repair. The company's main business scope is the design, manufacture, maintenance and sales of machinery, electrical equipment and accessories.

Due to the accelerated pace of industrial modernization in China, the application of various automation equipment and advanced production technology, in order to win market competition, enterprises are also facing the situation of optimization and upgrading. Although HD companies introduce specialized production equipment to improve production efficiency, but between the work stations the material transportation between equipments mostly depends on manpower and the efficiency is low, so the introduction of AGV is of great significance to the company.

3. 9 # Workshop modeling

The 9 # workshop is mainly engaged in the production and processing activities of a semi-finished product. According to the layout of the 9 # workshop, the workshop is divided into 14 areas, namely: power supply control cabinet, rework area, shipping area, slider sorter, station , Three-dimensional warehouse, electronic sorting area, processing area, cargo receiving area, incoming area, roller conveyor chain, incoming area, idle storage area and outgoing area; the 14 major areas are divided into A and B according to the positional relationship , C, D, E, F, G, H, I nine AGV operating points, as shown in Figure 1.

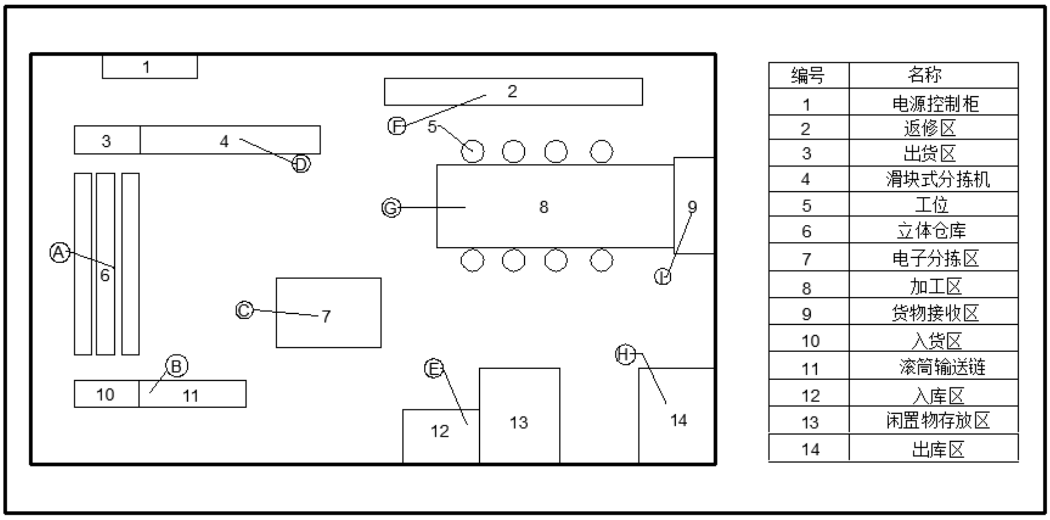

Fig. 1 9 # Workshop layout

According to the layout diagram, make the path diagram of AGV work, as shown in Figure 2.

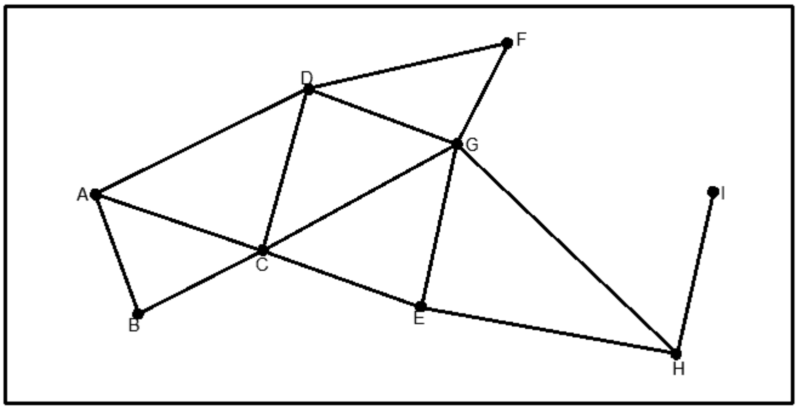

Fig. 2 AGV working path diagram

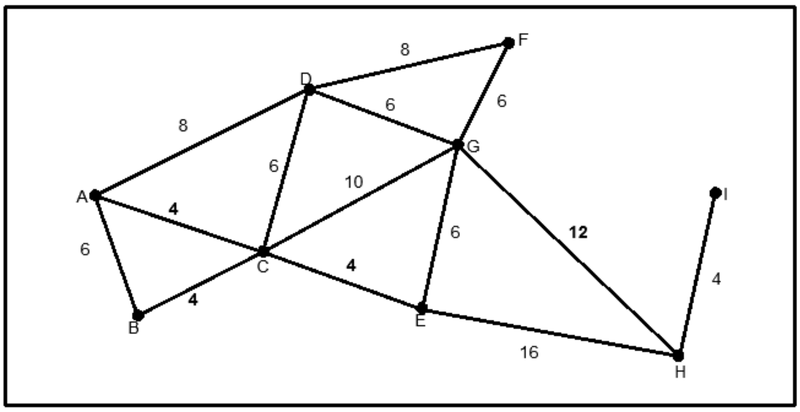

Fig. 3 Work path diagram of AGV with weight

According to the relationship between each working point, make a path diagram with weights, as shown in Figure 3.

4. AGV mission route

According to the main activities of Wu 9 # workshop, create AGV work tasks. The main work tasks of AGV are as follows:

(1) B-I (2) B-F (3) B-G (4) A-G (5) A-H (6) A-F.

The following uses B as the starting point and uses the Dijksttra algorithm to calculate the shortest path. The calculation steps are shown in Table 1.

Tab. 1 Work path diagram of AGV with weight

Algorithm steps	V collection	T collection
1	Select the initial node B, V = {B} There is only one node at this time, the shortest path is B → B = 0	T set is a set of points other than point B, T = {A, C, D, E, F, G, H, I}, where node A and node C are adjacent to B B → C = 4 B → A = 6, so B → C is the shortest path
2	Join node C, V = {B, C}, the shortest path is B → C = 4 Use C as an intermediate node and continue searching from path B → C.	Remove C from the set T, T = {A, D, E, F, G, H, I}, nodes A, D, E and G are adjacent to C. C → A = 4 C → E = 4 C → D = 6 C → G = 10, so the shortest path is B → C → A = 8, B → C → E = 8
3	Join nodes A and E, V = {B, C, A, E}, because B → A = 6 B → C → A = 8 Update the shortest path B → A, B → C, B → C → E, and continue searching from B → A and B → C → E.	Remove A and E from T, T = {D, F, G, H, I}, nodes G and H are adjacent to E; node D is adjacent to node A. E → G = 6 E → H = 16, so the shortest path B → A → D, B → C → E → G.
4	Join nodes D and G, V = {B, C, A, E, D, G}, because B → C → D = 10 B → A → D = 14; B → C → G = B → C → E → G = 14, Update the shortest path B → A, B → C, B → C → E, B → C → D, B → C → G and B → C → E → G, from the path B → C → D, B → C → G And B → C → E → G to continue the search.	Remove D and G from T, T = {F, H, I}, node F is adjacent to nodes D and G at the same time; node H is adjacent to node G. D → F = 8 G → F = 6 G → H = 12, so the shortest path B → C → D → F, B → C → G → F.
5	Join node F, V = {B, C, A, E, D, G, F}, because B → C → D → F = 18 B → C → G → F = 20 Update the shortest path B → A, B → C, B → C → E, B → C → D, B → C → G, B → C → E → G and B → C → D → F, from the path B → C → D → F is to continue searching.	Remove F from T, T = {H, I}, there is no node adjacent to F, update the shortest path to B → C → G → H, B → C → E → G → H.

6	Join node H, V = {B, C, A, E, D, G, F, H}, because B → C → E → H = 24 B → C → G → H = B → C → E → G → H = 26 Update the shortest path B → A, B → C, B → C → E, B → C → D, B → C → G, B → C → E → G, B → C → D → F and B → C → E → H, continue the search from path B → C → E → H.	Remove H from T, T = {I}, only node I is adjacent to H Therefore, the shortest path B → C → E → H → I.
7	Join node I, V = {B, C, A, E, D, G, F, H, I}, the shortest path B → A, B → C, B → C → E, B → C → D, B → C → G, B → C → E → G, B → C → D → F, B → C → E → H and B → C → E → H → I.	Set T is an empty set, the node search is completed, and the shortest path result is obtained.

According to the table, the shortest path of AGV main work tasks with B as the starting point is as follows:

(1) The shortest path of B-G is B → C → G = 14 and B → C → E → G = 14.

(2) The shortest path of B-F is B → C → D → F = 18.

(3) The shortest path of B-I is B → C → E → H → I = 28.

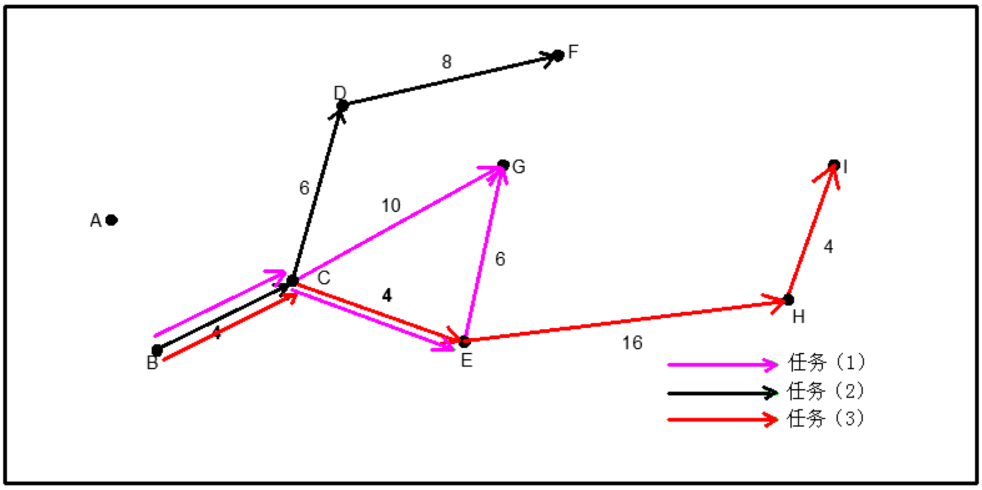

Fig 4 Working path starting from B

5. Conclusion

In the process of using Dijkstra's algorithm to plan AGV paths, some scholars have proposed optimization algorithms, but they do not have general adaptability. This article only proposes a strategy that is more in line with the actual application for the shortcomings of path planning. In the single AGV path obtained in the previous section, you can see that for task (1) B → G, there are two paths: B → C → G and B → C → E → G; for task (4) A → G, there are also two paths: A → C → G or A → C → E → G, but observation can find the path in task (1): B → C → G does not have a turn, and B → C → E → G has two turns; for the path in task (4): the turn of A → C → G is smaller than the path A → C → E → G. In actual situations, when the AGV faces a turn, it must slow down and slow down, which will waste time. Similarly, when the turn is too large, it will also waste time and even need to increase the path to make the turn, so in practical applications The rationality of the AGV operating path should be comprehensively evaluated. In this paper, paths B → C → G and A → C → G are obviously more reasonable

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