An Optimized Path Planning Using Dijkstra's Algorithm for Thematic Navigation Systems

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Abstract-**First, let's demystify the Dijkstras algorithm. As a classical single-source shortest path algorithm in graph theory, Dijkstras's algorithm can find the shortest path from one vertex to all other vertices. In the context of a theme park, each ride can be thought of as a vertex, and the walking path between them is the edge that connects the vertices. By assigning a weight to each edge, which is the estimated walking time between two rides, the Dijkstras algorithm is able to calculate the optimal path from either entrance or current location to all other rides.**

Keywords-shortest path theory; Dijkstras algorithm; path planning;Tour;Theme parks

1. INTRODUCTION

Suppose you are in a large theme park, facing intricate roads and a variety of amusement projects, how to choose a time-saving and efficient tour route has become a difficult problem for every tourist. In this case, the Dijkstras algorithm can be applied to the park's internal navigation system, which can provide a quantitative solution. The algorithm not only takes into account the distance, but also takes into account the actual influencing factors such as the waiting time in the queue, so as to plan an optimal tour path.

In summary, in the theme park, a place full of laughter and laughter, the Dijkstra algorithm is like a smart guide, which not only provides visitors with a scientific basis for path selection, but also makes more efficient use of the theme park's resources. While having a good time, guests can also appreciate the convenience and intelligence brought by technology, making every theme park trip more flawless. Through the Dijkstra algorithm, every visitor can enjoy the richest entertainment experience at the lowest cost, which is a wonderful gift brought to us by technological progress.

2. RELATED CONCEPTS

A. Mathematical description of Dijkstras' algorithm

For example, by collecting the waiting time of each attraction in real time and dynamically updating the weights of the edges in the graph, the Dijkstras algorithm can recommend a personalized tour route for each visitor. If you're a fan of thrilling roller coasters, the algorithm may suggest that you go straight to the most popular roller coaster attractions first to avoid longer wait times in the future, while if you're traveling with kids and prefer a warm merry-go-round, the algorithm will guide you to avoid rush hours and prioritize those with short wait times and a great experience.

$$\lim_{x\to\infty}(y_i \cdot t_{ij}) = \lim_{x\to\infty} y_{ij} \geq \max(t_{ij} \div 2) \quad (1)$$

In addition, the Dijkstras algorithm is extremely flexible.

$$\max(t_{ij}) = \partial(t_{ij}{}^2 + 2 \cdot t_{ij}) \succ \frac{1}{2}(\sum t_{ij} + 4)\mathrm{M} \quad (2)$$

Whether it is a temporary adjustment of the route due to weather changes, or a change in personal interests that requires a re-planning of the trip, the algorithm can respond quickly and output a new optimal path in real time. This is undoubtedly a great boon for theme park visitors who are looking for efficiency and individuality.

$$F(d_i) = \square\, \Pi \sum t_i \bigcap \xi \cdot \sqrt{2} \rightarrow \oint y_i \cdot 7 \quad (3)$$

B. Selection of tour path planning schemes

Of course, the implementation of any technology is inseparable from practical testing. To this end, many theme parks have begun to try to introduce intelligent navigation systems supported by the Dijkstras algorithm. Through the mobile app or on-site information screen, visitors can get personalized tour plans recommended by algorithms, and even make instant adjustments based on real-time data, making every trip a well-planned adventure.

$$g(t_i) = \ddot{x} \cdot z_i \prod F(d_i) \frac{dy}{dx} - w_i \quad (4)$$

To sum up, the application of Dijkstras algorithm in theme park tour path planning is not only a technological progress, but also an upgrade of tourists' participation experience.

$$\lim_{x\to\infty} g(t_i) + \lim_{x\to\infty} F(d_i) \leq \bigcap \max(t_{ij}) \quad (5)$$

With its unique computing advantages, it helps guests find their own perfect route in the vast park, ensuring that every second is immersed in joy and surprise.

$$g(t_i) + F(d_i) \leftrightarrow mean(\sum t_{ij} + 4) \quad (6)$$

C. Analysis of tour path planning schemes

In the future, with the continuous improvement of algorithms and the in-depth integration of technology, we have reason to believe that the Dijkstras algorithm will become synonymous with smart theme park tours and bring more exciting theme park trips to global tourists.

$$No(t_i) = \frac{g(t_i) + F(d_i)}{mean(\sum t_{ij} + 4)} \frac{n!}{r!(n-r)!} \quad (7)$$

In the management of modern theme parks and the optimization of visitor experience, the application of technology has become a force to be reckoned with.

$$Zh(t_i) = \bigcap [\sum g(t_i) + F(d_i)] \quad (8)$$

In particular, a well-designed route not only allows visitors to enjoy every wonderful moment, but also greatly improves the operational efficiency of the park. In this context, Dijkstra algorithm, as a powerful path planning tool, plays an increasingly prominent role in theme park tour path planning.

$$accur(t_i) = \frac{\min[\sum g(t_i) + F(d_i)]}{\sum g(t_i) + F(d_i)} \Gamma \quad (9)$$

Dijkstra's algorithm, as one of the representatives of the single-source shortest path algorithm, finds the shortest path from the starting point to all other nodes by assigning weights to nodes in the graph.

$$accur(t_i) = \frac{\min[\sum g(t_i) + F(d_i)]}{\sqrt{b^2 - 4ac} \sum g(t_i) + F(d_i)} + randon(t_i) \quad (10)$$

In the context of a theme park, we can think of rides as nodes, and the distance between them or the time it takes becomes the weight. Using the Dijkstra algorithm, we are able to provide a scientific and personalized tour plan for every visitor who enters the park.

3. OPTIMIZATION STRATEGIES FOR TOUR PATH PLANNING

First, consider the cost of the tourist's time. Theme parks tend to be vast in size and have many facilities, and how to experience the most fun in a short period of time is a concern for every visitor. Using the Dijkstra algorithm, we can calculate the most efficient route based on the time of visitor's visit, the expected length of stay, and the opening hours of each attraction. This path minimizes queuing and moving time while ensuring that visitors don't miss out on any popular items.

A. Introduction to the planning of the tour path

Secondly, personalized demand is the key word in the contemporary service industry. Different travelers have different needs and preferences, some may prefer thrilling activities, while others may prefer parent-child interactive experiences.

TABLE I. TOUR PATH PLANNING REQUIREMENTS

Scope of application	Grade	Accuracy	Tour path planning
Visitor experience optimization	I	85.00	78.86
	II	81.97	78.45
Tour route planning	I	83.81	81.31
	II	83.34	78.19
Attraction traffic control	I	79.56	81.99
	II	79.10	80.11

The Dijkstra algorithm can combine the personal preferences of tourists, assign different priority weights to different categories of amusement facilities, and then generate the optimal path that meets their individual needs.

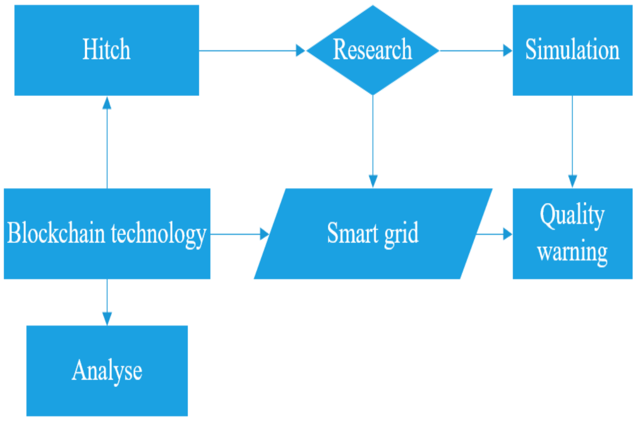

FIGURE I. THE ANALYSIS PROCESS FOR TOUR PATH PLANNING

In addition, theme park managers can leverage the Dijkstra algorithm for crowd control and traffic planning. At certain times, some popular facilities may have a large number of visitors, causing congestion.

B. Tour path planning

By collecting data in real time and applying the Dijkstra algorithm to dynamically adjust the recommended path, it can effectively disperse the flow of people and avoid congestion, thereby improving the overall satisfaction of tourists and reducing safety risks.

TABLE II. THE OVERALL PICTURE OF THE TOUR PATH PLANNING SCHEME

Category	Random data	Reliability	Analysis rate
Visitor experience optimization	85.32	85.90	83.95
Tour route planning	86.36	82.51	84.29
Attraction traffic control	84.16	84.92	83.68
Mean	86.84	84.85	84.40
X6	83.04	86.03	84.32
	P=1.249		

C. Tour path planning and stability

Finally, the Dijkstra algorithm also has positive significance for resource conservation. When visitors follow the optimal path, unnecessary travel and wandering can be reduced, which not only reduces the fatigue of visitors, but also reduces the transportation pressure and energy consumption within the park, and realizes environmentally friendly tourism.

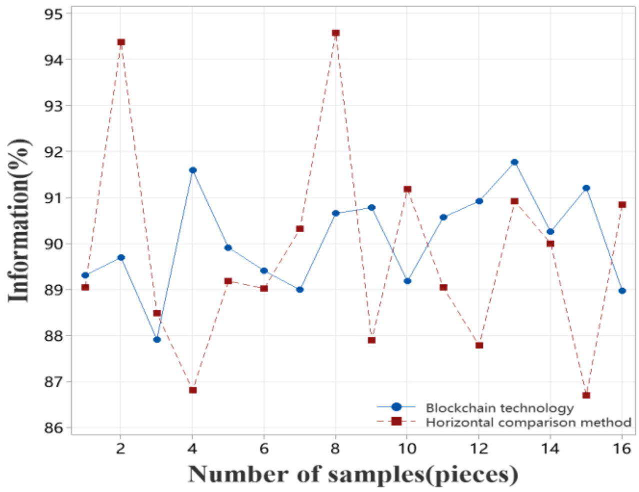

FIGURE II. TOUR PATH PLANNING WITH DIFFERENT ALGORITHMS

To sum up, the Dijkstra algorithm plays an extremely important role in the planning of the tour path of the theme park. It not only improves the visitor experience, enabling visitors to enjoy the park more efficiently and personally, but also helps managers optimize resource allocation and improve operational efficiency.

TABLE III. COMPARISON OF TOUR ROUTE PLANNING ACCURACY OF DIFFERENT METHODS

Algorithm	Survey data	Tour path planning	Magnitude of change	Error
Dijkstras algorithm	85.33	85.15	82.88	84.95
Machine learning algorithms	85.20	83.41	86.01	85.75
P	87.17	87.62	84.48	86.97

With the continuous advancement of technology, the combination of Dijkstra algorithm and theme parks will promote the entertainment tourism industry in a more intelligent and humane direction. It is worth mentioning that the Dijkstra algorithm can also assist in more detailed tour scheduling. By analyzing data on visitor traffic over different time periods, combined with the popularity and wait times of each attraction, the planning software can provide comprehensive recommendations for each visitor, including the best time to visit.

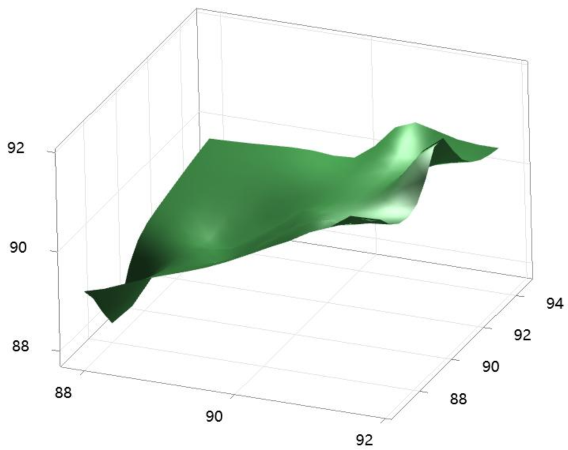

FIGURE III. TOUR PATH PLANNING WITH DIJKSTRAS' ALGORITHM

In such a rapidly changing era, theme parks must constantly innovate and take advantage of new technologies if they want to remain competitive. Integrating the Dijkstra algorithm into daily operation and management is not only an embrace of technology, but also a profound insight into the future trend of travel experience.

D. Rationality of tour path planning

Therefore, whether it is to achieve the perfect vacation for visitors or the long-term development of theme parks, the Dijkstra algorithm is an indispensable and powerful enabler.

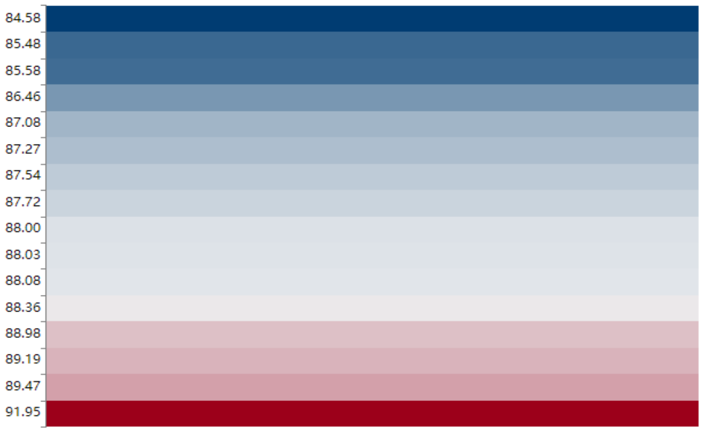

FIGURE IV. TOUR PATH PLANNING WITH DIFFERENT ALGORITHMS

With the continuous advancement of science and technology, all aspects of our lives have been affected by intelligence, including the optimization of leisure and entertainment methods. As an important part of modern entertainment life, theme parks are the focus of managers on their tour efficiency and visitor experience. In this context, the Dijkstra algorithm has become a powerful tool to improve the theme park experience with its unique advantages.

E.The effectiveness of tour path planning

Dijkstra algorithm is an algorithm used to find the shortest path between two vertices in a graph, and it is able to deal with the single-source shortest path problem in a weighted graph.

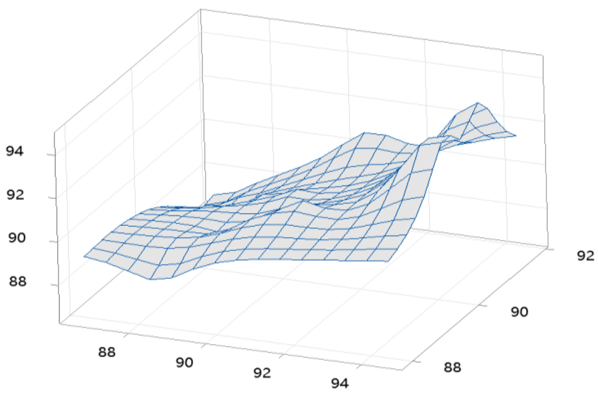

FIGURE V. TOUR PATH PLANNING WITH DIFFERENT ALGORITHMS

In a theme park scenario, we can think of each ride as a vertex in the graph, and the distance between the vertices can be considered as a weight of the path, such as walking time or length of the journey. Through this transformation, we are able to find the optimal path from the entrance to each facility in the complex theme park.

TABLE IV. COMPARISON OF THE EFFECTIVENESS OF TOUR ROUTE PLANNING OF DIFFERENT METHODS

Algorithm	**Survey data**	**Tour path planning**	**Magnitude of change**	**Error**
Dijkstras algorithm	82.21	85.92	84.59	82.85
Machine learning algorithms	83.73	84.23	84.41	83.55
P	84.20	87.39	84.76	83.90

To use the Dijkstra algorithm in theme park tour path planning, the map of the park needs to be digitized firstly. This includes recording the location of each attraction and the connectivity between them. Once this step is complete, the algorithm can simulate different path options in this virtual network diagram and finally determine a route that takes the least amount of time overall.

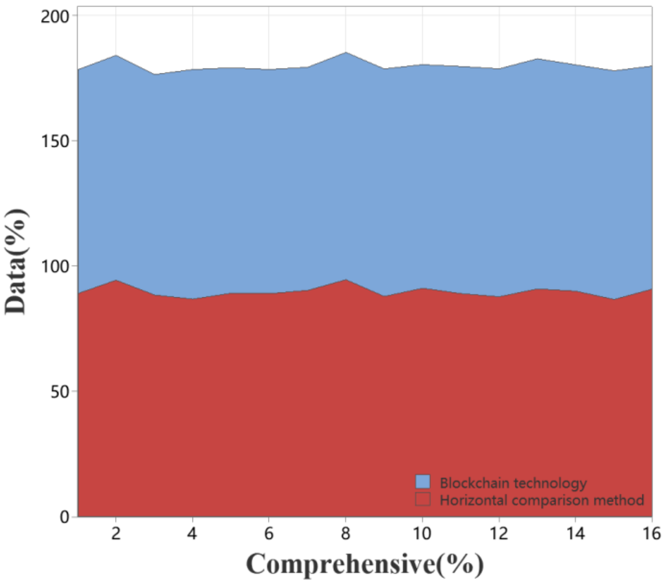

FIGURE VI. DIJKSTRAS ALGORITHMIC TOUR PATH PLANNING

For example, a traveler wants to visit as many rides as possible, but doesn't want to cover too many distances in a single day. This is where the Dijkstra algorithm comes in handy to help tourists plan an efficient visit. Based on the actual path between the starting point and the points to be visited, the algorithm calculates a golden route that meets the needs of the tour and saves energy.

4. CONCLUSION

In addition, the Dijkstra algorithm has shown its flexibility in dealing with unforeseen events in theme parks. Suppose a popular attraction is temporarily closed for maintenance, the algorithm can quickly adjust the route plan, avoid this point, and re-plan a new optimal tour sequence for guests. This dynamic route adjustment ability greatly enhances the experience of visitors.

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