Design and implementation of regional online ride-hailing scheduling algorithm

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Abstract: The network car has solved some problems of traditional taxis from the perspective of safety and convenience, but there are still gaps in the inter-city field. This paper proposes a scheduling method to solve the inter-city travel field from the regional perspective. Firstly, the platform of the system is built from the perspective of software development, and then the traditional scheduling algorithm for dispatching orders in the city is studied. Finally, the inter-city scheduling algorithm is mainly designed. This paper fills the gap in the field of inter-city travel between vehicles, and the scheduling algorithm performs well, with good order taking rate and travel efficiency. The establishment of the regional network car platform meets the needs of the public for inter-city travel. The platform itself has practical significance, and the study of scheduling algorithm also provides ideas and reference for the field of vehicle scheduling.

Keywords: Regional, Online Ride-Hailing, Scheduling Algorithm.

1. Introduction
Taxi travel is gradually increasing in daily life. There are two main modes of traditional ride-hailing. The first mode is "beckon to stop", in which drivers need to keep looking for passengers while driving, which is neither safe nor wasteful of fuel. The second type: telephone dispatching mode, compared with the "beckon to stop" mode, it is safer and saves fuel. However, direct communication between drivers and passengers cannot be carried out, and it will cause waste of time and human resources and has great drawbacks to distribute them through the dispatching center of the dealership. Nowadays, ride-hailing platforms have gradually become popular. The emergence of ride-hailing solves the drawbacks of the above two methods, eliminates all inter-mediate links, greatly saves time and human resources, and provides convenience for both drivers and passengers.

However, the current mainstream online ride-hailing platforms mainly provide services for city taxi and ride-hailing, which is not universally applicable to some cities. When passengers need to go back and forth between urban and rural areas and intercity, the journey and time are long. Many drivers are worried about returning without passengers and refuse to take orders. At this time, mainstream online ride-hailing platforms cannot provide convenient services for this part of passengers, and some passengers with this demand are lost. The regional characteristics of this platform aim to solve this problem and fill the gap of intercity travel. According to the investigation, there are a large number of
passengers in Changsha, Hunan who need to travel to and from Yiyang, Ningxiang, airports and other regions. The density of passengers and drivers using this route is relatively small, There are often cases of carpooling due to economic reasons and chartered cars due to hurry[1]. Therefore, this platform will solve this practical problem from a regional perspective.

Due to the particularity of inter-city travel, the platform only dispatches orders in sequence, and does not set up the order grabbing mode. For the idle drivers around, the platform calculates the dispatching sequence through the scheduling algorithm, and the drivers can choose whether to take orders or not according to the actual situation. When there are drivers with good cooperation in the sequencing, the system (or platform) will force the dispatch of orders, without setting the rejection entry, so as to improve the order receiving rate. At the same time, because the waiting time for dispatching orders for intercity travel is longer than that for city travel, if no orders are received within the specified time, the platform will expand the scheduling scope for scheduling, which is an improvement of the scheduling algorithm combined with the characteristics of intercity trips to improve the order receiving rate.

This article focuses on the design and implementation of the regional network ride-hailing platform, and the rest of this article is organized as follows. The second chapter is system design, which introduces the technical framework of system development, the design of passenger terminal, driver terminal, backstage management system; The third chapter is system implementation, which introduces the main functional modules of the system. The fourth chapter is the scheduling platform, which introduces the related situation and algorithm of network ride-hailing scheduling. Finally, the article summarizes the full text, draws a conclusion, and puts forward new thoughts and prospects.

2. System design of regional ride-hailing platform
This chapter mainly introduces the overall outline design of the network ride-hailing platform. It introduces the technical architecture of the network ride-hailing platform, and introduces the architecture of passenger terminal, driver terminal and Web backstage management system.

The whole framework design of the system is shown in Fig.1, which adopts the framework mode of Spring + Spring MVC + Mybatis, MySQL database server and Redis cache server, and JQuery + Bootstrap technology is adopted in front-end WEB[2][3].

![Fig.1 System Structure Diagram](image)

The network ride-hailing platform is designed by object-oriented design method, which consists of three parts: passenger terminal, driver terminal and backstage management system[4].
3. System implementation of regional ride-hailing platform
Through the previous chapters, the system is designed briefly. Therefore, this chapter focuses on the realization of the core functions of the ride-hailing platform. In this chapter, the network ride-hailing platform will be designed and implemented in detail according to business logic[5].

3.1. Passenger side design
Passengers can call the car through the passenger side. It includes the functions of inter-city trip, taxi and hitchhiking. The travel function can be used through the car calling module, including specific sub-functions such as order creation, order completion, payment and evaluation[6].

3.2. Driver side design
Drivers can take orders by taking the driver side. It includes the functions of inter-city trip, taxi and hitchhiking. The order receiving module can use the order receiving function, including order receiving setting, order pushing, order center, evaluation and other specific sub-functions[7].

3.3. Backstage management platform design
The backstage management system includes 11 functional modules: Scheduling platform, Order management, Driver management, Passenger management, Company management, Operation management, Blacklist management, System management, Statistical analysis, financial statements and Service management. The scheduling platform is the core module in the backstage management system[8].

4. Dispatching center of regional network car platform
Intercity scheduling platform includes order list, driver scheduling table, real-time operation chart and order list to be reassigned. Dispatchers timely dispatch orders for drivers and vehicles with the most reasonable order adaptation in intercity scheduling platform, and centrally and orderly dispatch orders for each driver and vehicle, so that passengers can get the best quality, convenient and timely service, and drivers and companies can get the most benefits with the most reasonable cost.

The platform uses Gaode Map API to obtain position information and path information[9][10], and Baidu Hawkeye is used to complete the path when the midpoint and path are lost in GPS positioning.

The dispatching algorithm of dispatching center mainly includes the following steps:
1) Locate the position of passengers by GPS, since the map is not a real plane, take it as a plane approximately, take the driver as the center, take K as half length, define a square area, and judge all n drivers in this area. The length of k half is determined according to the city size and population density. The K region is shown in Fig. 2.

```javascript
// Create an approximately square area
var path = [
    [113.031778,28.214074],
    [113.031778,28.174074],
    [113.091778,28.174074],
    [113.091778,28.214074]
];

// Create the driver's location
var marker = new AMap.Marker(
    map: map,
    draggable: true,
    position: [113.021778,28.204074]
);

function compute()
{
    var point = marker.getPosition();
    var isPointInRing = AMap.GeometryUtil.isPointInRing(point, path);
```
marker.setLabel({
  content:isPointInRing?'inside':'outside',
  offset:new AMap.Pixel(20,0)
});

![Map Image]

**Fig.2** Captures The Driver In The K Area

2) Call "Path Planning API" and "Path Length API" to get the distance between N drivers and passengers[11]. The result of path generation is shown in Fig. 3, and the distance corresponding to the path is shown in Fig. 4.

Main code for using path planning API:

```javascript
var driving = new AMap.Driving(drivingOption);
//Plan the driving route according to the starting and ending coordinates
driving.search([{keyword:'Changsha Railway Station',city:'0731'},
{keyword:'Hunan University',city:'0731'}],
 function(status,result){
  button.onclick = function(){
    driving.searchOnAMAP({
      origin:result.origin,
      destination:result.destination
    });
  }
}
});
```

![Map Image]

**Fig.3** Path Generation

**Fig.4** Distance Calculation Diagram

Main code for using path length API:

```javascript
var arr=new Array(); //Array of longitude and latitude coordinates
arr.push(new AMap.LngLat("113.011778","28.194074");
arr.push(new AMap.LngLat("112.955031","28.195996");
arr.push(new AMap.LngLat("112.955085","28.198152");
arr.push(new AMap.LngLat("112.957045","28.197929");
arr.push(new AMap.LngLat("112.953551","28.178828");
arr.push(new AMap.LngLat("112.947024","28.179528");
```
//Define polyline objects
polyline=new AMap.Polyline(
    path:arr,  //Set the node array of polylines
    strokeColor:"red",
    strokeOpacity:1,
    strokeWeight:3,
    strokeDasharray:[10,5]
);

3) Select the ten nearest drivers, and calculate their shortest distance and shortest time by function[12][13].

\[
D_{\text{min}} = \min \{D_1, D_2, D_3, \ldots, D_{10}\} \quad (1)
\]

\[
T_{\text{min}} = \min \{T_1, T_2, T_3, \ldots, T_{10}\} \quad (2)
\]

For the time and distance of ten drivers, the comprehensive ranking score is calculated by distance influence factor A and time influence factor B.

\[
S_i = \left( \frac{D_i}{D_{\text{min}}} \right) \times A + \left( \frac{T_i}{T_{\text{min}}} \right) \times B \quad (i = 1.2.3\ldots10)
\]

(3)

Sorting Si in ascending order to get iSortList.

4) Dispatch orders for drivers in turn according to the order in iSortList. If no one takes orders, it will be extended to N-10 drivers in K area (excluding the ten drivers who did not take orders before), and then repeat step 3). If no one still takes orders, the order will fail[14][15].

\[
S_i = \left( \frac{D_i}{D_{\text{min}}} \right) \times A + \left( \frac{T_i}{T_{\text{min}}} \right) \times B \quad (i = 11.12.13\ldotsN)
\]

(4)

5. Summary and prospect
Firstly, this article narrates and explains the project backstage management, illustrates the research significance of the project according to the project background, and introduces the current development status of the project. And expounds the organizational framework of the article.

In the second chapter, the related technologies are introduced, including the introduction of system, MVC design pattern and Gaode map API. After that, the modules of passenger terminal, driver terminal, backstage management are designed and implemented in detail.

This article focuses on the analysis of the scheduling platform in the backstage management system, and makes a detailed study of the algorithm used in the scheduling process.

In the subsequent system development, thread safety should be considered, so as to provide good support in the face of large traffic concurrency, and to check whether the normal operation of the system has an impact. In the face of epidemic situation, we can add modules to show body temperature and health, and keep pace with the times.

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