Secure And Synchronized City-Scale Taxi Ridesharing

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Abstract: A taxi-sharing system is proposed and developed that accepts taxi passengers’ real-time ride requests and schedules proper taxis to pick them up via ridesharing, subject to time, capacity, and monetary constraints. The monetary constraints provide incentives for both passengers and taxi drivers: passengers will not pay more compared with no ridesharing and get compensated if their travel time is lengthened due to ridesharing; taxi drivers will make money for all the detour distance due to ridesharing. While such a system is of significant social and environmental benefit, e.g., saving energy consumption and satisfying people’s commute, real-time taxi-sharing has not been well studied yet. To this end, a mobile-cloud architecture based taxi-sharing system is devised. Taxi riders and taxi drivers use the taxi-sharing service provided by the system via a smart phone App. The Cloud first finds candidate taxis quickly for a taxi ride request using a taxi searching algorithm supported by a spatio-temporal index. A scheduling process is then performed in the cloud to select a taxi that satisfies the request with minimum increase in travel distance. Proposed system demonstrated its efficiency, effectiveness and scalability. For example, when the ratio of the number of ride requests to the number of taxis is 6, proposed system serves three times as many taxi riders as that when no ridesharing is performed while saving 11 percent in total travel distance and 7 percent taxi fare per rider.

I. INTRODUCTION

Taxi is an important transportation mode between public and private transportations, delivering millions of passengers to different locations in urban areas. However, taxi demands are usually much higher than the number of taxis in peak hours of major cities, resulting in that many people spend a long time on roadsides before getting a taxi. Increasing the number of taxis seems an obvious solution. But it brings some negative effects, e.g., causing additional traffic on the road surface and more energy consumption, and decreasing taxi drivers income (considering that demands of taxis would be lower than number of taxis during off-peak hours).

II. RELATED PROBLEM

Taxi Recommendation and Dispatching

Suggests some parking places for an individual taxi driver towards which they can find passengers quickly and maximize the profit of the next trip.

Taxi dispatching services usually send a taxi close to a passenger as per the passenger’s call without considering taxi-sharing. Consequently, only vacant taxis need to be examined for each dispatch, which can be easily retrieved by answering a range query.

Carpool often refers to ridesharing which deals with routine commutes. There are already websites and mobile Apps for this purpose, such as Avego.

Taxi Recommendation and Dispatching systems are only designed from the perspective of taxi drivers Dial-a-ride problem (DARP) have primarily focused on the static DARP, where all customer ride requests are known in priori. Since the general DARP is NP-hard, only small instances can be solved optimally.

III. PROBLEM ANALYSIS

To a taxi-sharing system that accepts taxi passengers’ real-time ride requests and schedules proper taxis to pick them up via taxi-sharing with time, capacity, and monetary constraints. Taxi drivers independently determine when to join and leave the service. Passengers submit real-time ride requests. Each ride request consists of the origin and destination of the trip, time windows constraining when the passengers want to be picked up and dropped off.

On receiving a new request, the Cloud will first search for the taxi which minimizes the travel distance increased for the ride request and satisfies both the new request and the trips of existing passengers who are already assigned to the taxi, subject to time, capacity, and monetary constraints.

Then the existing passengers assigned to the taxi will be inquired by the cloud whether they agree to pick up the new passenger given the possible decrease in fare and increase in travel time. Only with a unanimous agreement, the updated schedules will be then given to the corresponding taxi drivers and passengers. This system saves energy consumption and eases traffic congestion while enhancing the capacity of commuting by taxis.

It reduces the taxi fare of taxi riders and increases the profit of taxi drivers. Real-time taxi-sharing has not been well explored, though ridesharing based on private cars, often known as carpooling or recurring ridesharing, was studied for years to deal with people’s routine commutes, e.g., from home to work. Proposed ridesharing model considers more
practical constraints which include time windows, capacity, and monetary constraints for taxi trips. Efficient searching and scheduling algorithms that are capable of allocating the “right” taxi among tens of thousands of taxis for a query in milliseconds.

The cloud integrates multiple important components including taxi indexing, searching, and scheduling. Specifically, propose a spatio-temporal indexing structure, a taxi searching algorithm, and a scheduling algorithm. Supported by the index, the two algorithms quickly serve a large number of real-time ride requests while reducing the travel distance of taxis compared with the case without taxi-sharing.

Provide incentives not only for passengers but also for taxi drivers: passengers will not pay more compared with no ridesharing and get compensated if their travel time is lengthened due to ridesharing; taxi drivers will make money for all the reroute distance due to ridesharing. The monetary constraints makes modeling of the taxi ridesharing problem more realistic.

IV. IMPLEMENTATION

**Taxi and status**

A taxi status V represents an instantaneous state of a taxi and is characterized by the following fields, which are updated by a taxi driver to the server. V:ID. The unique identifier of the taxi V:t. The time stamp associated with the status. V:l. The geographical location of the taxi at V:t. V:s. The current schedule of V, which is a temporally-ordered sequence of origin and destination points of n ride requests Q1, Q2; . . .Qn such that for every ride request Qi, i ¼ 1; . . . ;n, either 1) Qi : o precedes Qi : d in the sequence (referred to as the precedence rule thereafter), or 2) only Qi:d exists in the sequence. V:r. The current projected route of V, which is a sequence of road network nodes calculated based on V:s. vehicle capacity is also set at server. The number of riders that sit in the taxi does not exceed the number of seats of a taxi at any time.

**Rider and status**

A rider submits a new ride request Q to the Communication Server. All incoming ride requests of the system are streamed into a queue and then processed according to the first-come-first serve principle. Rider updates the current location and destination, where he/she wants to reach.

**Taxi schedule**

The schedule of a vehicle status is dynamic, i.e., changes over time. If the taxi driver put his vehicle under parking, then the taxi status should be updated. Similarly, if he wants to take a ride, then

the destination and corresponding route should be updated to server. The schedule of taxi makes the system perfect to give the exact results of available taxi to riders.

**Taxi searching**

The taxi searching module quickly selects a small set of candidate taxis with the help of the spatio-temporal index. The spatio-temporal index of taxis is built for speeding up the taxi searching process. Specifically, partition the road network using a grid. We have partitioned the road networks by for an example, 0-100 region1, 100-200 region2 etc. The range is 100 for ev ery region, in which the taxi and riders are scheduled.

V. RESULT ANALYSIS
VI. CONCLUSION

Developed a mobile-cloud based real-time taxi-sharing system. Detail interactions between end users (i.e. taxi riders and drivers) and the Cloud is studied. The system based on a GPS trajectory data set generated by 33,000 taxis over three months, in which over 10 million ride requests were extracted. The experimental results demonstrated the effectiveness and efficiency of our system in serving real-time ride requests. Firstly, proposed system can enhance the delivery capability of taxis in a city so as to satisfy the commute of more people. For instance, when the ratio between the number of taxi ride requests and the number of taxis is 6, our proposed system served three times as many ride requests as that with no taxi-sharing. Secondly, the system saves the total travel distance of taxis when delivering passengers, e.g., it saved 11 percent travel distance with the same ratio mentioned above.

VII. REFERENCES


AUTHOR'S PROFILE

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