A COMPUTER-IMPLEMENTED METHOD, AND A SERVER

Technical Field

The invention relates generally to the field of logistics and/or transport. One aspect of the invention relates to a computer-implemented method. Another aspect of the invention relates to a server.

Background

In terms of logistics, it may be useful to optimise available driver vehicles amongst a number of concurrent delivery or transport bookings. Sometimes, this may mean that a redistribution of driver vehicles is necessary, if the supply and demand is not well geographically matched.

In order to achieve the optimum allocation, it may be necessary to divide a geographic territory into smaller areas in order to reduce the computational complexity for real time allocation and to reduce any latency in allocating vehicles. Within each smaller area, it will be necessary to try to match supply and demand and to optimise the allocation of the delivery and/or transport vehicles.

For example, in CN113240339 and CN114912740 two different approaches are given for optimising the allocation of the delivery and/or transport vehicles for deliveries and/or passengers.

It may be desirable to provide a more effective or efficient solution in some applications.

Summary

Embodiments may be implemented as set out in any of the independent claims. Some optional features are defined in the dependent claims.

Implementation of the techniques disclosed herein may provide significant technical advantages. Advantages of one or more aspects may include one or more of the following:

- The technical solution of faster processing of orders based on the technical problem of sub optimal allocation of bookings to driver vehicles.
- The technical solution of reduction in the amount of communication traffic due to less cancelled orders based on the technical problem of sub optimal allocation of bookings to driver vehicles.
- The technical solution of reduced data centre energy requirements based on the technical problem of sub optimal allocation of bookings to driver vehicles.
- The technical solution of reduced greenhouse emissions based on the technical problem of sub optimal allocation of bookings to driver vehicles. Because the orders are limited to those with the most efficient allocation, there may be less wasted trips by drivers, or less wasted sales by merchants, and therefore greenhouse emissions for any unnecessary trips or unnecessary product manufacturing may be avoided.
- The technical solution of reduced data centre storage requirements based on the technical problem of sub optimal allocation of bookings to driver vehicles.
- The technical solution of improved transport experience by allowing drivers to arrive at customers at the minimum amount of time, avoiding waiting time for the customer and/or long travel times for the driver, based on the technical problem of sub optimal allocation of bookings to driver vehicles.
- The technical solution of improved data quality and accuracy, based on the technical problem of sub optimal allocation of bookings to driver vehicles.
- The technical solution of reduced server hardware required for the technical problem of sub optimal allocation of bookings to driver vehicles. Reduced greenhouse emissions may result from less manufacturing of hardware.

- The technical solution of reduced bandwidth requirements based on the technical problem of sub optimal allocation of bookings to driver vehicles. Reduced greenhouse emissions may result from less communications bandwidth requirements.
- The technical solution of less latency for the technical problem of sub optimal allocation of bookings to driver vehicles.

In an exemplary implementation, the functionality of the techniques disclosed herein may be implemented in software running on a handheld communications device, such as a mobile phone. The software which implements the functionality of the techniques disclosed herein may be contained in an “app” – a computer program, or computer program product – which the user has downloaded from an online store. When running on the, for example, user’s mobile telephone, the hardware features of the mobile telephone may be used to implement the functionality described below, such as using the mobile telephone’s transceiver components to establish the secure communications channel, or a GPS location chip to identify the location of the user.

In an exemplary implementation, the functionality of the techniques disclosed herein may be implemented in software running on a server communication apparatus (such as a one or more servers, one or more virtual machines, one or more processors or a cloud computing platform), which communicates with the applications running on the user terminals, driver terminals and/or merchant terminals such as mobile phones. The software which implements the functionality of the techniques disclosed herein may be contained in a computer program, or computer program product. The server communication apparatus establishes secure communication channels with the driver, merchant and/or user terminals, for allocating passengers and/or deliveries to drivers, and dynamically determines an optimal spatial-temporal distribution of supply and / or demand across the whole territory.

Brief Description of the Drawings

The invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 is a schematic block diagram illustrating an exemplary delivery/transportation service.

Figure 2 is a schematic block diagram illustrating an exemplary communications server for the delivery/transportation service.

Figure 3 is a schematic diagram of a proposed Supply Positioning Score system.

Figure 4 is a schematic diagram of the first step in the SPS system of Figure 3.

Figure 5 is a schematic diagram of the second step in the SPS system of Figure 3.

Figure 6 is a schematic diagram of the third step in the SPS system of Figure 3.

Figure 7 is a schematic diagram of the fourth step in the SPS system of Figure 3.

Figure 8 is a screenshot of an example of driver nudging.

Figure 9 is a screenshot of an example of incentive planning.

Detailed Description

The techniques described herein are described primarily with reference to use in allocating delivery bookings to delivery or transport vehicles. This may be useful to optimise overall efficiency.

Figure 1 shows an exemplary architecture of a system 100, with a number of users each having a communications device 104, a number of merchants each having a communications device 109, a number of drivers each having a user interface communications device 106, a server 102 (or geographically distributed servers) of a delivery platform provider and communication network 108 connecting each of the components. Each user contacts the server 102 using a user software application (App) on the communications device 104. Similarly, the drivers and merchants may use an app on their devices 106, 109.

A platform provider may use the system 100 for the purpose of logistics and/or transport management. This may involve deliveries or e-commerce-based transactions, where a customer orders some food, a product, or other physical item needing delivery. This may involve transportation, where multiple adjacent customers may order a vehicle, where one vehicle is then shared to transport each customer to multiple adjacent destinations, or where each customer has their own vehicle. Typically, the system 100 used by the platform operator will facilitate transactions between the users, and goods or services providers such as drivers or merchants. The system 100 may then be used to simultaneously optimise the allocation of available delivery vehicles (including different applicable delivery vehicle types) for transport of delivery bookings and/or passengers.

For deliveries or e-commerce-based transactions, the user device 104 may allow the users to input queries containing the keywords for the items of interest and delivery addresses. The user may see a list of merchants and/or items provided by the merchants, and order items from the merchants. The merchant may contact the server 102 using the merchant device 109 for providing information about their items and receiving orders for each confirmed transaction. The driver contacts the server 102 using the driver device 106. The driver device 106 allows the drivers to indicate their availability to take the delivery jobs, information about their vehicle, their location. The server 102 may then match drivers to the delivery, based on, for example: geographic location of merchants and drivers, maximising revenue, user or driver feedback ratings, weather, driving conditions, traffic level / accidents, relative demand, environmental impact, and/or supply levels. The user may be offered a particular delivery cost and approximate delivery ETA. If the user accepts the offer, the server 102 may go through a payment authorisation process. If the authorisation is approved, the merchant will then be notified and directed to provide goods for the driver to pick up. The selected driver will then be notified and directed to the pickup location to pick up the goods. The driver may be optimised to pick up goods from several merchants and drop off the series of orders in a single efficient path. During

the delivery, the user device 104, the driver's device 106, the merchant's device 109 and the server 102 may be updated with real-time trip information including the real-time location of the driver's vehicle, the destination, the driver fare and/or other trip-related information. After the trip the driver's device 106 may send a confirmation that the trip has ended to server 102. Once the transaction is approved and/or the delivery is completed, the user device 104, the driver's device 106, the merchant's device 109 and the server 102 may be updated with details of the completed financial transaction. This allows an efficient allocation of resources because the available fleet of drivers is optimised for the users' demand in each territory.

For transportation, the user device 104 may allow the user to enter their pickup location, a destination address, one or more service parameters, and/or after-ride information such as a rating. The one or more service parameters may include the number of seats of the vehicle, the style of vehicle, level of environmental impact and/or what kind of transport service is desired. Each driver contacts the server 102 using a driver app on the communication device 106. The driver app allows the driver to indicate their availability to accept jobs, information about their vehicle, their location, and/or after-ride info such as a rating. The server 102 may then match users to drivers, based on, for example: geographic location of users and drivers, maximising revenue, user or driver feedback ratings, weather, driving conditions, traffic level / accidents, relative demand, environmental impact, and/or supply levels. The user may be offered a particular transport cost, or a range based on different types of vehicles, and an approximate ETA. If the user accepts the offer, the system may go through a payment authorisation process. If the authorisation is approved, the selected driver will then be notified and directed to the pickup location to pick up the user/passenger. This may be optimised for several users wishing to share a vehicle to lower the trip cost, or single vehicles. During the trip, the user device 104, the driver's device 106, and/or the server 102 may be updated with real-time trip information including the real-time location of the driver's

vehicle, the destination, the trip fare and/or other trip-related information. At the conclusion of the trip, the driver's device 106 may send a confirmation the trip has ended to server 102. Once the transaction is approved and/or trip completed the user device 104, the driver's device 106, and/or the server 102 may be updated with details of the completed financial transaction. This allows an efficient allocation of resources because the available fleet of drivers is optimised for the users' demand in each territory.

Referring to Figure 2, further details of the components in the system of Figure 2 are now described. The communication apparatus 100 comprises the communication server 102, and it may include the user communication device 104, the merchant communication device 109 and the driver communication device 106. These devices are connected in the communication network 108 (for example, the Internet) through respective communication links 110, 111, 112, and 114 implementing, for example, internet communication protocols. The communication devices 104, 106 and 109 may be able to communicate through communication networks and/or protocols, including cellular communication networks, LAN, WAN, private data networks, VPN, fibre optic connections, laser communication, microwave communication, satellite communication, Bluetooth, Wifi, NFC, etc., but these are not specified in Figure 2 for the sake of clarity.

In the example shown in Figure 2, the communication server apparatus 102 may comprise several individual components including, but not limited to, one or more microprocessors 116, one or more memories 118 (e.g., a volatile memory such as a RAM), and/or longer-term, non-volatile, or persistent, memory 119 (e.g., SSD (Solid State Drive) or Hard disk drives (HDD)) for the loading of executable instructions 120, the executable instructions defining the functionality the server apparatus 102 carries out under the control of the microprocessor 116. The communication server apparatus 102 also comprises one or more input/output modules 122 allowing the server to communicate over the communication network 108. One or more user

interfaces 124 are provided for administrator control and may comprise, for example, computing peripheral devices such as display monitors, computer keyboards and the like.

The communication server apparatus 102 may be a single server as illustrated schematically in Figure 2. Alternatively, the functionality performed by the server apparatus 102 may be distributed across multiple physically or logically separate server components. In the context of the present specification, "a server", “the server” or “said server” is a computer program that is running on appropriate hardware and is capable of receiving requests (e.g., from electronic devices) over a network, and carrying out those requests, or causing those requests to be carried out. The hardware may be implemented as one or more physical computers, one physical computer system, one or more virtual machines, or a cloud-based server network. In the present context, the use of the expression a "server" is not intended to mean that every task (e.g. received instructions or requests) or any particular task will have been received, carried out, or caused to be carried out, by the same physical server (i.e. the same software and/or hardware); it is intended to mean that any number of software elements or hardware devices may be involved in receiving/sending, carrying out or causing to be carried out any task or request, or the consequences of any task or request; and all of this software and hardware may be one server or multiple servers. The same approach is to be taken for references to other systems, software or hardware components e.g., processor, memory, storage etc.

Here the transactions referred to may be payments done for anything the platform provider offers, for e.g., Ride-hailing, Ride-sharing, food delivery, e-commerce deliveries, etc. Transactions can include any interaction where a user, driver or merchant requests the platform provider to provide services or products, request transportation, accepts orders or deliveries, or otherwise communicate with the platform provider.

The server apparatus 102 may also comprise one or more databases 126 stored in volatile memory 118 and/or non-volatile memory 119, for storing data, which may include data on merchant behaviour, geographic information, images, products, points of interest, users, drivers, merchants, transaction data, aggregated data or parameters, payment data, and other relevant data. The data may be stored in a data structure according to the requirements of the application, or as described in more detail below. The database 126 may be replicated, distributed, sharded or otherwise optimised according to the requirements of the application.

The user communication device 104 may comprise several individual components including, but not limited to, one or more microprocessors 128, a memory 130 (e.g., a volatile memory such as RAM), and/or longer-term memory such as flash memory or SSD (Solid State drives) for the loading of executable instructions 132, the executable instructions defining the functionality the user communication device 104 carries out under the control of the microprocessor 128. The user communication device 104 also comprises an input/output module 134 allowing the user communication device 104 to communicate over the communication network 108. A user interface 136 is provided for user control. If the user communication device 104 is, say, a smartphone or tablet device, the user interface 136 will have a touch panel display as is prevalent in many smartphones and other handheld devices. Alternatively, if the user communication device 104 is, say, a desktop or laptop computer, the user interface 136 may have, for example, computing peripheral devices such as display monitors, computer keyboards and the like.

The merchant communication device 109 may be, for example, a smartphone or tablet device with the same or a similar hardware architecture to that of the user communication device 104. In some instances, or applications, merchants may also be labelled as users.

The driver communication device 106 may be, for example, a smartphone or tablet device with the same or a similar hardware architecture to that of the user communication device 104. Alternatively, the functionality may be integrated into a bespoke device such as a taxi fleet management terminal or other logistics terminals.

The driver mentioned above may also be implemented by a remote driver or an autonomous driver. Examples include autonomously driven vehicle, UAVs, and drones. In that case, the merchant may be responsible for loading the order with the delivery vehicle, or that task may be automated as well.

Thus, it will be appreciated that Figures 1 and 2 and the foregoing description illustrate and describe a system 100 comprising:

a communication server 102;

at least one user communication device 104 having an associated user and configured to request a booking which includes a pick up and drop off location;

at least one driver communication device 106 having an associated delivery vehicle and configured to provide vehicle location data; and

communication network equipment 108 configured to establish communication with the communications server 102, at least one user 104 or merchant 109 communication device, and at least one driver communication device 106;

wherein the communications server comprises at least one processor(s) 116, at least one memory 118, the server 102 being configured, under control of one or more of the at least one processor(s) 116, to execute instructions stored in one or more of the at least one memory 118 to:

receive a plurality of bookings from user communication devices 104 and store the plurality of bookings in the memory 118;

receive a plurality of vehicle location data from the driver communication devices 106 and store the plurality of vehicle location data in the memory 118;

store a geographic division of a platform provider territory into a plurality of areas in the memory 118;

compare the number of bookings, and the number of driver vehicles, in each of the plurality of areas to the overall supply and demand for the platform provider territory to provide a relative supply demand score for each of the plurality of areas; and

send a signal to one or more user 104, driver 106 communication device to encourage or discourage anticipatory movement of driver vehicles and / or bookings between the plurality of areas depending on the relative supply demand scores.

Further, it will be appreciated that Figures 3 to 7 illustrate and describe a method performed in a communication server apparatus 102, the method comprising, under control of a microprocessor 116 of the communication server apparatus 102:

storing 302 data for the origin and destination locations of a plurality of requested bookings in a memory 118;

storing 302 data for locations of a plurality of idle driver vehicles in the memory 118;

storing 302 a geographic division of a platform provider territory into a plurality of areas in the memory 118;

comparing 304 a supply measure, and a demand measure, in each of the plurality of areas to the overall supply and demand for the platform provider territory to provide a relative supply demand score for each of the plurality of areas; and

transmitting signals to encourage or discourage anticipatory movement of one or more idle driver vehicles and / or requested bookings between the plurality of areas depending on the relative supply demand scores.

In an example embodiment, a Supply Positioning Score (SPS) is determined of relative demand vs supply in each area. This may useful because supply investments across areas should be proportional to their value contribution. In either the transportation or delivery examples given above, if the geographic territory of the platform provider is divided up into areas, it is possible to determine whether there are local supply / demand constraints. The SPS may be used to measure the relative supply and demand to more optimally distribute vehicles to each area.

There are 4 steps involved in the process of determining the SPS as shown in a first example in Figure 3. The steps are calibrating current distribution of demand & supply 302, identifying overshaped & undershaped areas 304, measuring the 'effort' needed to reach ideal distribution 306 (this gives us the Supply Positioning Score), and moving supply from over shaped to under shaped.

The measuring effort step 306 uses supply, and / or demand management levers (such as surge, promotions, fare cuts) to optimize the effort - the lower the effort is, better are the marketplace outcomes.

Determine relative supply and demand for each area

Calibration 302 of the current distribution of demand and supply, is shown in more detail in Figure 4 for the first example. The requests 402 are shown as "+" and the idle drivers 404 are shown as "Δ". The geographic territory may be a city, which is divided into 9 areas – A1-A9. In each area, there may be an imbalance between the demand (requests 402) and the supply (idle drivers 404).

Identify score for each area

In order to measure the amount of imbalance, a process 304 for identify overshaped and undershaped areas is shown in Figure 5 for the first example.

First, we calculate the vector of supply share, denoted *s*, with *s_i* for area *i = 1, … , n*. Depending on the context, supply can be variously defined as the number of idle drivers, or the idle time spent by drivers. For example, if it is the idle time spent by drivers it can be calculated using Equation (1):

$$Supply\ Share\ at\ area\ i, s_i\ = \frac{Dax\ Idle\ Hours\ in\ Area\ i\ at\ Hour\ b}{Total\ Dax\ Idle\ Hours\ in\ the\ city\ at\ Hour\ b} \quad (1)$$

Hence, s_i can be interpreted as the proportion of idle supply in area *i* and $s_1 + \ldots + s_n = 1$

Secondly, we construct a vector of demand share, denoted *d*. Demand can be defined as ride requests, Gross Merchandise Value (GMV) or Revenue from the ride requests. Using GMV or Revenue over a period of time provides a more averaged measure, compared to instantaneous level of requests. For example, demand may be calculated using Equation (2):

$$Value\ Share\ at\ area\ i, d_i\ = \frac{Value\ in\ Area\ i\ at\ Hour\ b}{Total\ Value\ in\ the\ city\ at\ Hour\ b} \quad (2)$$

Alternatively, if we construct it using Unique Requests, *d_i* can be interpreted as the proportion of total Unique Requests in each area *i.* $d_1 + \ldots + d_n = 1$.

Referring again to the example in Figure 5 A1, A2 and A7 are undershaped 502, and A3, A5, A8 and A9 are overshaped 504. In this context, undershaped means a relative supply demand score for that area under a value of 1, meaning there is a *relative* deficit and ideally needs vehicles moved there. Overshaped means a relative supply demand score for that area over a value of 1, meaning there is a *relative* excess, and is able to supply vehicle for other areas.

In a second example as shown in Table 1 A1, A3 and A5 are undershaped and A2, A4, and A6 are overshaped.

	Supply	Demand	Supply Share	Demand Share	Supply Share / Demand Share
A1	20	40	18.18%	23.53%	0.77 (under)
A2	30	40	27.27%	23.53%	1.16 (over)
A3	10	20	9.09%	11.76%	0.77 (under)
A4	20	20	18.18%	11.76%	1.55 (over)
A5	10	20	9.09%	11.76%	0.77 (under)
A6	20	30	18.18%	17.65%	1.03 (over)

Table 1

Effort to reach ideal distribution

Effort is defined as the fraction of idle drivers that need to be moved to reach ideal positioning. For example, a supply position score may be determined according to Equation (3)

$$SPS = f(s,d) \ \epsilon \ [0,1] \qquad (3)$$

SPS may be a function that takes the 2 vectors of supply and value shares, and returns a value between 0 and 1 that summarizes the gap between the supply and demand in terms of how many drivers need to be moved. As we only look at fractions of total supply or demand, we have controlled away fluctuations in total supply and demand. In the very short term, supply is fixed. SPS helps us make the best use of available idle drivers.

Expressed in terms of the *s, d*, it can be computed according to Equation (4):

$$Supply\ Positioning\ Score\ (SPS) \ = \ \sum_{i=1}^{n} max(0, s_i \ - \ d_i) \ \epsilon \ [0,1] \qquad (4)$$

where s_i, d_i *are the i-th element of vectors {s, d}, and n is the number of areas in the network*.

In the second example the SPS may be calculated below using number of idle drivers as the supply and number of rides or requests as the demand as shown in Table 2:

	Supply	Demand	Supply Share s_i	Demand Share d_i	Supply Share / Demand Share or zero if undefined	Ideal Supply [Demand Share * Total Supply]	Amt. of excess or deficit supply [Supply – ideal Supply] (+ indicates excess, - indicates deficit)	$\max(0, s_i - d_i)$
A1	20	40	18.18%	23.53%	0.77	25.882	-5.882	0%
A2	30	40	27.27%	23.53%	1.16	25.882	+4.118	3.74%
A3	10	20	9.09%	11.76%	0.77	12.941	-2.941	0%
A4	20	20	18.18%	11.76%	1.55	12.941	+7.059	6.42%
A5	10	20	9.09%	11.76%	0.77	12.941	-2.941	0%
A6	20	30	18.18%	17.65%	1.03	19.412	+0.588	0.53%

Table 2

According to Equation (4), SPS for the second example, can be calculated as the sum of the last column in Table 2:

SPS = 3.74% + 6.42% + 0.53% = 10.69%

SPS helps to quantify the level of imbalance in supply distribution compared to the ideal state for the marketplace. A higher SPS score indicates that a larger proportion of the supply in the marketplace has to be moved in order to achieve matching geospatial distribution for supply and demand.

The effort needed to reach ideal distribution 306 for the first example is shown in Figure 6. Supply share / demand share sets the base. Based on this, we compute ideal supply. The last step compares this ideal supply to actual supply - which gives us how many drivers to move. The calculation of the SPS for the first example is shown in Table 3. The calculated SPS is useful to know at the city level the state of the marketplace from a positioning perspective. This enables benchmarking across cities (something like SPS for SG is x%, compared to Jakarta which has an SPS of y%).

The relative supply demand score in the 6th column (Supply Share s_i / Demand Share d_i) for each area is what is used to determine which areas to shift demand and / or supply to and from. If the relative supply demand score is below one that area is said to be undershaped, or relatively undersupplied, so that vehicles may be moved to that area or that demand should be reduced in that area. If the relative supply demand score is above one that area is said to be overshaped, or relatively oversupplied, so that vehicles may be moved from that area or that demand should be increased in that area.

	Supply	Demand	Supply Share s_i	Demand Share d_i	Supply Share / Demand Share or zero if undefined	Ideal Supply [Demand Share * Total Supply]	Amt. of excess or deficit supply [Supply - ideal Supply] (+ indicates excess, - indicates deficit)	max(0, s_i - d_i
A1	1	0	10%	0%	0	0	+1	10%
A2	2	0	20%	0%	0	0	+2	20%
A3	0	2	0%	20%	0	2	-2	0%
A4	3	0	30%	0%	0	0	+3	30%
A5	1	2	10%	20%	0.5	2	-1	0%
A6	1	1	10%	10%	1	1	0	0%
A7	1	1	10%	10%	1	1	0	0%
A8	1	3	10%	30%	0.33	3	-2	0%
A9	0	1	0%	10%	0	1	-1	0%

Table 3

According to Equation (4), SPS for the first example, can be calculated as the sum of the last column in Table 3:

SPS = 10% + 20% + 30% = 60%

Move supply from over shaped to under shaped

Generally, we would increase surge for trips going from a relatively undershaped to overshaped area & vice versa in order to move supply from overshaped to undershaped, and/or to move demand from undershaped to overshaped.

In the short run, surge is a demand side measure. For instance, consider three passengers in Area A3 wanting to travel to Areas A1, A4 & A6 respectively (in the second example in Table 2). Under the SPS model, the A3-> A1 route is expected to have surge (since A1 is equally undershaped as A3, sending drivers to A1 will make A3 more undershaped). The A3-> A6 route would experience some surge (since A6 is overshaped compared to A3). Conversely, the A3 to A4 route would see a substantial surge (since A4 is highly overshaped compared to A3). This surge structure is likely to encourage bookings to A1, while deterring bookings to A4/A6. As an indirect outcome, the chances of having more drivers go up in A1 while simultaneously reducing drivers' ending up in A4/A6.

Another way of achieving this outcome is to nudge drivers to move from over shaped areas to undershaped areas. In Figure 8, an example is given of nudging drivers (via the app) present in overshaped areas (like A2) to move to nearby under shaped areas (like A3).

The algorithm starts with a list of candidates determined as follows: the relative supply / demand score in col 6 is used to determine which areas to shift demand / supply to or from. The amount of excess or deficit supply in column 8 tells is used to determine how many vehicles to move from each area. This gives a list of candidate areas and number of vehicles that can be moved.

The next step is to decide which particular areas to nudge candidate vehicles to go to:

1. The area with the highest level of excess demand and the highest level of deficit supply will be matched (so lowest undershaped area vs. highest overshaped area in col. 6), and nudge will be sent to the drivers in the high supply areas (according to col 8).
2. Should there be areas with the similar levels of excess supply (in col 8), the distance and/or driver rating between the high supply excess area and each of the high supply deficit areas will be calculated – a nudge will then be sent to the drivers that are the closest to the high supply deficit area.

If we find some areas to be chronically undershaped, we could have incentives for drivers to show up in those areas. In Figure 9, an example is given of spot Bonus for rides taken in A3/A8/A9 in the first example.

Another way of achieving this outcome is Shift Planning. For areas that are consistently undershaped (such as A3/A8/A9 in the first example), enlist drivers to operate exclusively within these zones.

Generally, any of the examples of shifting supply or influencing demand may be implemented by transmitting a signal to at least one user communication device 104, and / or at least one driver communication device 106. This signal ultimately results in the tangible movement of vehicles which leads to a technically more efficient or optimum distribution of vehicles compared other prior art systems. The signal may be calculated or determined in order to encourage or discourage supply in a given area, e.g., anticipatory movement of one or more idle driver vehicles and / or demand in a given area, e.g., requested bookings between the plurality of areas. The signal will depend on the relative supply demand scores as discussed.

Experimental Results

It should be noted that overshaped 502, and undershaped 504 are characterisations of relative supply demand scores, not simply a score for each local area supply vs

demand. To illustrate this in more detail, tables 4 and 5 below compares the outcome between relative supply demand scores for one or more of the present embodiments vs local area supply /demand scores.

Table 5 shows that in the second example the relative supply demand score would recommend increasing surge specifically for rides going from A1 -> (A2/A4) while decreasing surge for rides going from A2 -> A1/A4. Using a local area supply /demand score, in the alternative methods (in column 3 and 4 of table 5), would not generate this recommendation because they use local supply /demand scores.

Area	Idle Supply / Drivers	Demand (Ride Requests)	Allocated Rides	Utilized Drivers	Market clearing score if lambda = 0.5
A1	20	40	20	20	20/40+20/20
A2	30	40	10	10	10/40+10/30
A3	10	20	10	10	10/20+10/10
A4	20	20	20	20	20/20+20/20
A5	10	20	5	5	5/10+5/20
A6	20	30	20	20	20/30+20/30

Table 4

	relative supply demand score	Patent 1 (Effective Demand Supply)	Patent 2 (Market Clearing Score assuming lambda = 0.5)
A1	Undershaped (0.77)	Under supplied (0.5)	1.5
A2	Overshaped (1.16)	Under supplied (0.75)	0.58
A3	Undershaped (0.77)	Under supplied (0.5)	1.5
A4	Overshaped (1.55)	Ideal Balance (1)	2
A5	Undershaped (0.77)	Under supplied (0.5)	0.75
A6	Overshaped (1.03)	Under supplied (0.666)	1.32

Table 5

Patent 1 refers to US Patent publication number 20230419342, the contents of which are incorporated herein by reference. Patent 2 refers to US Patent publication number 20220114609, the contents of which are incorporated herein by reference.

Claims

1. A computer implemented method performed in a communication server apparatus for a platform provider, the method comprising, under control of a processor of the communication server apparatus:

storing data for the origin and destination locations of a plurality of requested bookings in a memory;

storing data for locations of a plurality of idle, available or soon to be available driver vehicles in the memory;

storing a geographic division of a platform provider territory into a plurality of areas in the memory;

comparing a supply measure, and a demand measure, in each of the plurality of areas to the overall supply and demand for the platform provider territory to determine a relative supply demand score for each of the plurality of areas, based on the stored data; and

transmitting signals to encourage or discourage, anticipatory movement of one or more of the driver vehicles, and / or the requested bookings between the plurality of areas depending on the relative supply demand scores.

2. The method according to claim 1, further comprising determining a Supply Positioning Score (SPS) based on the relative supply demand scores.

3. The method according to claim 1, further comprising determining relative demand for each area.

4. The method according to claim 3, further comprising determining relative supply for each area.

5. The method according to claim 4, wherein the relative supply demand score for each of the plurality of areas is determined by dividing the relative supply for that area by the relative demand for that area.

6. The method according to claim 5, wherein determining the SPS includes determining the ideal relative supply for each area.

7. The method according to claim 6, wherein the ideal relative supply for each area is calculated according to the Demand Share for that area multiplied by the Total Supply.

8. The method according to claim 7, wherein determining the SPS includes determining the amount of relative excess or deficit supply for each area.

9. The method according to claim 8, wherein the amount of relative excess or deficit supply for each area is calculated according to the Supply for that area minus the Ideal Supply for that area.

10. The method according to claim 8, wherein determining the SPS includes summing all positive values of the Supply Share minus the Demand Share for each area.

11. The method according to claim 8, wherein the signal is determined based on using the relative supply demand score to determine which areas to shift demand / supply to or from, and the amount of relative excess or deficit supply is used to determine how many vehicles to move.

12. The method according to claim 8, wherein the signal is further determined based on moving vehicles from the areas of the highest relative supply demand score (overshaped) to the lowest relative supply demand score (undershaped).

13. The method according to claim 12, wherein the signal is still further determined based on the distance between the areas of supply excess and the areas of supply deficit and/or a driver rating.

14. The method according to claim 1 wherein the supply measure includes the number of idle drivers in each area, or the time spent by drivers in each area over a predetermined period.

15. The method according to claim 1 wherein the demand measure includes the number of unallocated bookings, GMV or Revenue.

16. The method according to claim 1 wherein the signals to encourage and/or discourage anticipatory movement of one or more idle driver vehicles and / or requested bookings include prioritizing bookings going from undershaped to overshaped areas, lower the surge for bookings from overshaped areas to undershaped areas, increase the surge for bookings from undershaped areas to overshaped areas, driver incentives to move to undershaped areas, promotions for drivers to take bookings from overshaped areas to undershaped areas, shift planning, and / or driver nudges.

17. A computer program or computer program product comprising instructions for implementing the method according to claim 1.

18. A computer program carrier carrying the computer program or computer program product according to claim 14, wherein the computer program or computer program product is one of an electronic signal, optical signal, radio signal or computer-readable storage medium.

19. A non-transitory tangible computer-readable storage medium storing the computer program or computer program product according to claim 14.

20. A system comprising:

a communication server;

at least one user communication device having an associated user and configured to request a booking which includes a pick up and drop off location;

at least one driver communication device having an associated delivery vehicle and configured to provide vehicle location data; and

communication network equipment configured to establish communication with the communications server, at least one user communication device, and at least one driver communication device;

wherein the communications server comprises at least one processor(s), at least one memory, the server being configured, under control of one or more of the at least one processor(s), to execute instructions stored in one or more of the at least one memory to:

receive a plurality of bookings from user communication devices and store the plurality of bookings in the memory;

receive a plurality of vehicle location data from the driver communication devices and store the plurality of vehicle location data in the memory;

store a geographic division of a platform provider territory into a plurality of areas in the memory;

compare the number of bookings, and the number of idle, available, or soon to be available driver vehicles, in each of the plurality of areas to the overall supply and demand for the platform provider territory to determine a relative supply demand score for each of the plurality of areas, based on the data stored in the memory; and

send a signal to one or more user, or driver communication device to encourage or discourage, anticipatory movement of the

driver vehicles, and / or the bookings between the plurality of areas, depending on the relative supply demand scores.

21. A communication server apparatus for a platform provider, the communication server comprising at least one processor, the communication server apparatus being configured, under control of one or more of the at least one processors, to execute instructions, to:

receive a plurality of bookings from user communication devices and store the plurality of bookings in the memory;

receive a plurality of vehicle location data for idle, available, or soon to be available driver communication devices and store the plurality of vehicle location data in the memory;

store a geographic division of a platform provider territory into a plurality of areas;

compare a supply measure, and a demand measure, in each of the plurality of areas to the overall supply and demand for the platform provider territory to determine a relative supply demand score for each of the plurality of areas, based on the data stored in the memory; and

send a signal to one or more user, or driver communication device to encourage or discourage, anticipatory movement of the driver vehicles, and / or the bookings between the plurality of areas depending on the relative supply demand scores.

22. A user communication device for a user, the user communication device comprising a processor and a memory, the user communication device being configured, under control of the processor, to execute instructions stored in the memory, to:

initiate an unallocated delivery booking to a communication server, wherein the unallocated delivery booking includes a pick up and drop off location;

receive a confirmation from the communication server confirming that a driver vehicle has been allocated, wherein the allocation of the driver vehicle is determined by:

comparing a supply measure, and a demand measure, in each of a plurality of areas of a platform provider territory to an overall supply and demand for the platform provider territory to determine a relative supply demand score for each of the plurality of areas; and

encouraging or discouraging. anticipatory movement of the driver vehicles. and / or the bookings between the plurality of areas depending on the relative supply demand scores.

23. A user communication device, or a driver communication device, for a delivery platform provider, the user communication device, or the driver communication device comprising a processor and a memory, the user communication device, or the driver communication device, being configured, under control of the processor, to execute instructions stored in the memory, to perform the method according to claim 1.