The Use of GPS Technology to Improve the Arrival Time of Customers to the Work Site

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Abstract:

At present, there are many countries with a medium economic level and also a low level that has no public transport network such as the tram or metro, not even a bus network or School Bus Routing but transportation is done by private efforts that the state does not participate in. These efforts may be represented by taxi owners and owners of medium and small private buses that adopt to transfer Students, employees, and workers from their homes to places of work with monthly wages.
nThis private transportation process faces several problems on the part of the user, who is the student, employee, or worker, such as the difficulty of finding the driver near the place of residence or finding a group of participants in the same vehicle whose places are near his place of residence, or if their housing is located on the road leading to the workplace like school or university, the time also if suits to everyone in terms of time to start work and time to end work. From the other part the vehicle owner, he finds it difficult to find better customers in terms of their nearest to the place of residence of the vehicle owner, or it is located on the road leading to the place of work. The second problem is finding the shortest road that passes through all the subscribers in the vehicle with less time and less cost which has been treated in an application called *Ishtraki* whereby the participants from students, employees, and workers are distributed to the closest vehicle driver and then find the best road for each vehicle driver as a road map to use it to reach all his participants as the shortest way.

INTRODUCTION:

In developing countries, transportation to and from the workplace, school, or university is a large-scale problem that involves every family, there are no public transport networks that the citizen can benefit from it to go to work, university, school, etc. And if the government is far from an initial or radical solution to this problem, an alternative must be found and reliance on special efforts away from the state to solve this problem It was necessary to think about an application that performs this purpose and take advantage of modern technologies to facilitate the process of transportation to and from the worksite, university, school, and others, to increase performance to provide the lowest costs by saving the customer's time that wasted in searching for a vehicle's driver close to their home and searching for a suitable group of participants with the same goal in the same Vehicle and reduce the time to reaching the target by using the best route that is obtained when using the application. In addition to other advantages such as reducing traffic congestion, thus reducing traffic accidents, reducing fuel consumed and less consumption of resources such as the vehicle.[6][10]

PROBLEM DEFINITION:

<u>Practical Part:</u>

The practical part consists of several application interfaces:

1- The first interface is Home Page and it contains the login button if there was a previous registration, the registration button when entering the application for the first time, and a third button to update the data.

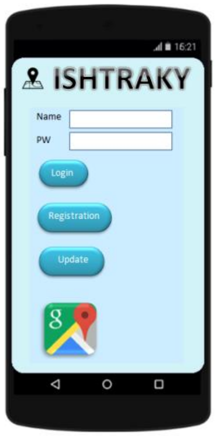

Figure (1)

2- The second interface requires determining whether the user is a driver of a vehicle or a customer, who may be a student or employee.

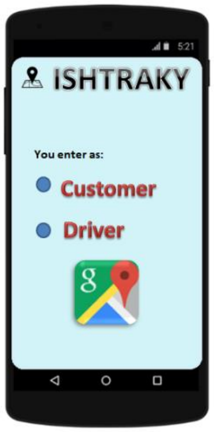

Figure (2)

3- The third interface appears if the answer is in the second interface a customer, where this interface contains the customer's data such as the name, age, gender, residential address, address of the target or the place he wants to reach, and a button to go to Google Maps to obtain the location coordinates for the customer's address and the address of the business or The object of study is what we call the target.

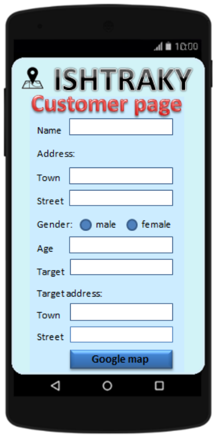

Figure (3)

4- The fourth interface appears if the answer is in the second interface as a vehicle driver, as this interface contains data Q from the name, age, gender, type of vehicle, model, number of seats and housing address, and a button to move to Google Maps to obtain the location coordinates of the vehicle driver's address.

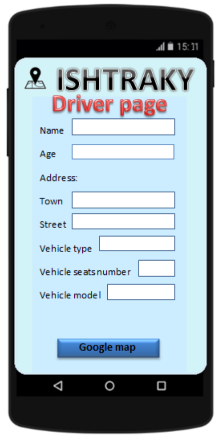

Figure (4)

5- The fifth interface displays the map of a specific driver and his customers.

Figure (5)

Application steps:

The practical part of this application can be represented as two stages that explained below:

Stage number one: stage no. one consists of two cases:

• **The first case:** If the user is the owner of the vehicle or it is possible to call him the driver and after the form is filled out by the driver and his data is entered that includes name, age, type of vehicle, vehicle model, vehicle capacity or what we mean by the number of seats, the address of the driver and then Determine its location using Google Maps, where the coordinates of its location will be determined from longitude and latitude, and then these coordinates are stored in a table for vehicle drivers using Google Maps and we get the data in the form of an excel file or a KML file.

• **The second case:** When the user is either a student or an employee, we can call him the customer where he enters his required data, including the customer's name, age, gender, the customer's address, the target, or the place that the customer wants to go to, then the coordinates of the customer's location from longitude and latitude are determined. Display and store these coordinates in a customer's table, determine the target coordinates, and store these coordinates in a table for the targets and obtain the best path length between the customer and the target, estimated in kilometers using Google Maps, then store all these coordinates in a database where can get these data, as an excel file or KML file.

Stage number two:

The second stage consists of five steps:

After obtaining the coordinates of the locations of each customer, the customer's target, and the coordinates of the driver's location, the stage of processing this data begins as follows:

First step: Determine the first target:

Second step: After obtaining the data of both the customer and the driver:

I) All customers who have the same goal calculate the distance between customer and target which call it **customertarget** distance is arranged in ascending order according to the distance between the target and the customer from closest to farthest.

II) For each driver, the distance between the target and the driver is calculated called **drivertarget** distance, and the list of vehicle drivers is arranged in ascending order concerning the distance between the target and the driver.

III) The distance between the target and the driver is considered the **standard distance** to be compared with.

IV) We start from the first driver:

V) To find the right customer, who is the one closest to either the target or the driver, the distance is calculated as follows:

A. Starting from the first customer:

*B. We calculate the distance between the customer and the drive calls it **customer driver** distance.*

C. We calculate:

***Total distance = customertarget** distance **+ customerdriver** distance.*

*D. Comparing the **total distance** with the **standard distance**, the higher the **total distance** is less than the **standard distance**, the more the vehicle driver's favorite customer will be.*

E. Moving to the next customer, and whether he is the last customer.

F. If it is not the last customer who did have the same goal, and then return to point B.

*G. Customers are arranged in ascending order according to the amount of the **total distance**, so the smaller it is, the more ideal customer for the driver.*

VI) The first group is reserved for this driver, the number of which is the number of seats in his vehicle.

VII) This driver is marked as (Full) which means that the vehicle occupied all its seats.

VIII) Each customer in this group is marked as X, meaning that he has obtained the appropriate vehicle to transport him to the target.

IX) The driver who (Full) is marked is excluded from entering the comparison again.

X) The customer who has an X marked also
is excluded from entering the comparison again.

XI) Moving to the next driver, is he the last driver or the last customer?

XII) If not the last, return to point V.

Third step: Moving to the next goal, and is it the last goal?

Fourth step: Return to step # 2.

Fifth step: Excluding customers who got the X mark and vehicle drivers who got the full mark.

Stage number three:

The third stage takes each group which consisting of the target, the driver, and the customers and the distances between driver and target, the distance between driver and customer, and the distan

ce between target and customer then represent in the form of a graph. The target, driver, and customer are represented as graph's vertices then the driver is the start point and the target is the endpoint of the graph to find the best way to reach the target from the start point through all customers in the group using the traveling salesman algorithm. After the TSP algorithm is executed the result of the algorithm is represented as a map on the mobile display for the driver to be followed to transport customers to the worksite or the university as the best way to deliver customers to the desired target.[9]

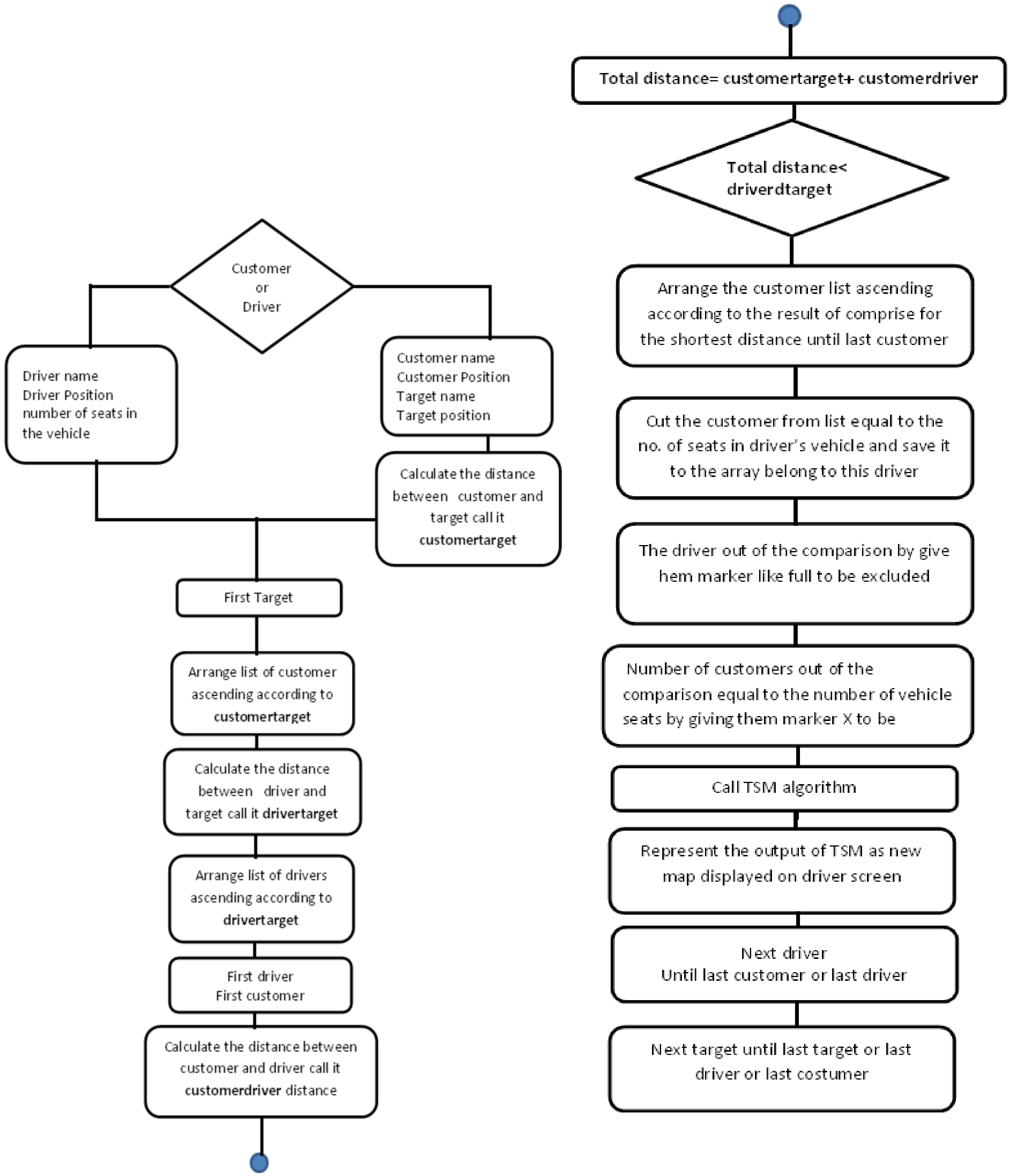
Customer
or
Driver
Driver name
Driver Position
number of seats in
the vehicle
Customer name
Customer Position
Target name
Target position
Calculate the distance between customer and target call it **customertarget**
First Target
Arrange list of customer ascending according to **customertarget**
Calculate the distance between driver and target call it **drivertarget**
Arrange list of drivers ascending according to **drivertarget**
First driver
First customer
Calculate the distance between customer and driver call it **customerdriver** distance
Total distance= customertarget+ customerdriver
Total distance< driverdtarget
Arrange the customer list ascending according to the result of comprise for the shortest distance until last customer
Cut the customer from list equal to the no. of seats in driver's vehicle and save it to the array belong to this driver
The driver out of the comparison by give hem marker like full to be excluded
Number of customers out of the comparison equal to the number of vehicle seats by giving them marker X to be
Call TSM algorithm
Represent the output of TSM as new map displayed on driver screen
Next driver
Until last customer or last driver
Next target until last target or last driver or last costumer

Figure (6)

GPS TECHNIQUES:

The Global Positioning System (GPS) is one of the technologies that have great importance, which is represented by a network of monitoring stations and satellites that send a free signal. This signal is used for positioning, navigation, and timing (PNT). This technology has become accurate, everywhere, and reliable, which made this system a global positioning system as well as a platform that helps innovation and this tremendous ability to measure periods and frequencies with great accuracy enables the users of this global positioning system (GPS) To determine location anywhere, anytime in the world.

This comparison of multiple timing signals allows for three general applications to:

- An application that takes advantage of the ability to determine the exact location (**Latitude and Longitude Distance)** of a feature or object.[7]
- An application that makes use of the possibility of comparison between the current and the desired position.
- An application that takes advantage of the path, altitude, and velocity corrections to guide an object to the desired position. [2][5]

THE TRAVELLING SALESMAN ALGORITHM (TSP):

To clarify this issue, we assume that there is n number of points and roads between all of them with known lengths, which means that it is easy to find the shortest path between any two points. The goal of this question is to find the shortest path, which passes through all the points simultaneously, the starting point and the ending point are different. The goal is to find the shortest round trip possible, this is not the problem, the real problem, in this case, is necessary to try all possible ways between all points and this is the exact problem that will take the largest part of the execution time. When the points are five or six points, the problem is not complicated. But if the problem contains thousands of points, then it turns into a dilemma that ordinary computers will not be able to solve these problems. [3][11]

To calculate the efficiency of this algorithm, we use Big O to measure the time it takes to implement this algorithm and the extent to which the time required for implementation varies by changing the number of inputs, for example, O (1) is simply constant in the sense that time does not depend on the input, O (n) means that the time is linear proportional With the input quantity, O (n2) is squared, which means that time is square the input. In the case of TSP, the input is the set of points or places and the distances between each pair of these places and there are n! ways to order n objects (n permutations). A worst-case scenario mathematically defines the absolute worst an algorithm can perform; these are described as the ratio of the worst possible to the optimal solution the figure () show the number of possibilities.

Count of points	Count of possible ways
4	24
5	120
6	720
7	5 040
8	40 320
9	362 880
10	3 628 800
11	39 916 800
12	479 001 600
13	6 227 020 800
14	87 178 291 200
15	1 307 674 368 00
16	20 922 789 888 000
17	355 687 428 096 000
18	6 402 373 705 728 000
19	121 645 100 408 832 000
20	2 432 902 008 176 640 000
25	15 511 210 043 330 985 984 000 000

Figure (7)

In the application, we determine the Vehicle capacity, not more than ten seats and we start in filling Vehicle with the smallest vehicle capacity at least four customers which possible way equal 24 and at most 10 customers which possible way equal 3,628,800 [2][9]

EXPERIMENTAL RESULTS:

The data acquired from Google maps like the location of the customer, location of the driver, and location of target which saved as an excel file the table below for university of Mosul as target and it is a first target T1 and the customer from C1 to C15 then the drivers from D1 toD5 and the no. of seat for it is vehicle like 4D5 for four seats for driver 5.

NAME	LAT	LOG
T1	43.1421683	36.37649
C1	43.14738133	36.37314
C2	43.13682283	36.37568
C3	43.13744736	36.37133
C4	43.15428849	36.38498
C5	43.15467632	36.3853
C6	43.15908371	36.38533
C7	43.1590181	36.38529
C8	43.15901809	36.38525
C9	43.15005273	36.39201
C10	43.14607796	36.3946
C11	43.14722583	36.39898
C12	43.15179398	36.40014
C13	43.14006501	36.39465
C14	43.13316822	36.38082
C15	43.13110046	36.38039
C16	43.13283356	36.38097
C17	43.13356524	36.37812
C18	43.16132807	36.38999
C19	43.17448776	36.3909
C20	43.16235145	36.38248
6D1	43.16538564	36.3885
4D2	43.144956	36.39181
7D3	43.13756172	36.37376
4D4	43.17209974	36.37747
4D5	43.13784121	36.36624
15D6	43.16163205	36.40025

Figure (8)

The first group consists of six customers for the driver no. one which the map for the best way selected to transformed these customers to their target university of Mosul as shown in the graph below

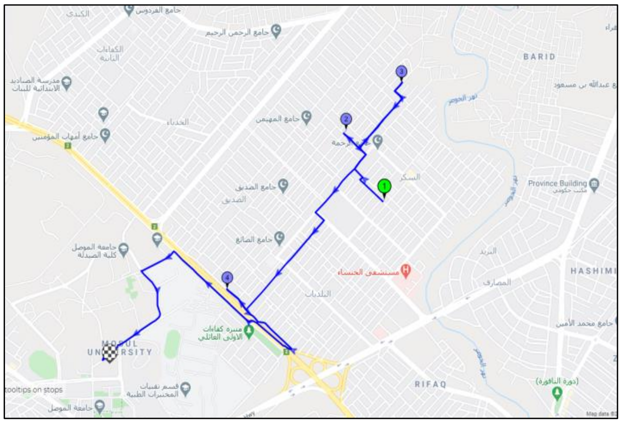

Figure (9)

DISCUSSION:

1- When entering data for the driver, it is possible to ask the driver to specify the goals that he can reach. Less storage space and shorter comparison time because this process will limit the number of comparisons between drivers to find the driver closest to the target, otherwise all drivers will be taken into consideration without exception.

2- Determined the size of the vehicles used for transportation, the vehicle's maximum capacity would not exceed ten passengers. This option is positive on two sides, the first from the customer's side, where the time spent will be directly proportional to the number of customers in the vehicle. The greater the number of customers, the greater the time to reach the goal, because the tour to all customers will be larger, meaning that it takes longer. On the other hand, finding the best way by using the traveling salesman algorithm, the degree of complexity of this algorithm, or what is called big O Calculate the complexity of the algorithm.

3- The distance between the driver and the target was considered as a standard distance if we chose the closest customer to the driver the customer A is best than customer B but when seeing the graph customer B is better because it is located on the way to the target, therefore, we use the distance between driver and target as stander distance so even customer A is closer than customer B to the driver but customer B is better to choose it to be in the group of this driver where the distances will be arranged distance from the best distance according to how close they are to the standard distance, as shown in the figure below.[8]

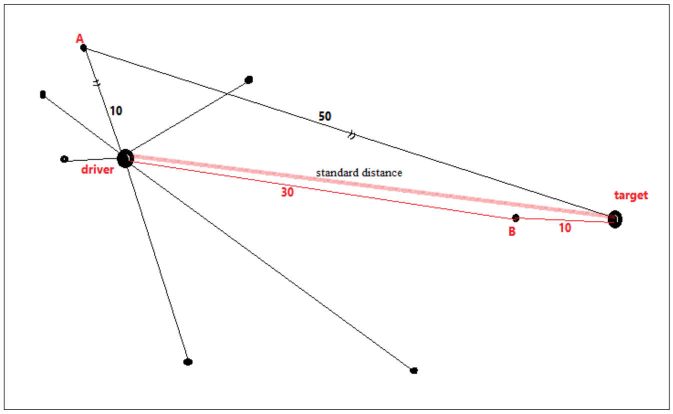

Figure (10)

4- Isolate customers into groups or lists according to the goal, where the special list includes a specific goal, for example, the goal is the University of Mosul, which includes all customers from teaching staff, employees, and students, and it is possible to classify this list into a more accurate list, a list for employees and workers and a list for students. These lists could contain other sub-lists, where the students' list would contain a list for males and a list for females.

5- Updating may be monthly via the Update button for the customer or the driver to be entered again in the comparison series.
6- If the place of residence moves or the goal changes from school to university, there will be no problem, just updating the data and giving the new information.
7- Away from the ISHTRAKI application, the mode of transportation was done randomly which leads to irregularity in traffic. It was causing momentum in a certain place because of the large number of vehicles that may contain one user or two users only, and vehicles may take non-ideal ways to reach customers, which leads to an increase in the fuel consumption required for transportation. Fuel consumption is required for transportation.

CONCLUSIONS:

The application used to solve the problem of transformation in many countries that Which suffers from the lack of services that must be provided by their governments, which in turn will save a lot of time and effort necessary to find a means of transportation in the right place and the right time and for the convenience of users and thus saving in the resources like fuel and consumption in the vehicle and a small percentage of accidents that can occur due to randomness in transportation.

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