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Optimized Food Delivery Network based on Spatial Crowdsourcing

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Abstract:- In recent years, with the prevalence of the mobile Internet, Online Takeout Ordering & Delivery (OTOD) using smart phones has become an emerging service. The user could receive the take-out food delivered by the restaurant staff after ordering through OTOD service. In addition, new platforms have been emerged and service has been rendered through OTOD. Different from the standard delivery method the take-out food is delivered independently by staffs of various restaurants. The merchants who register in these platforms could share the resources of professional delivery staffs to scale backthe value. OTOD service is convenient and time saving especially for those who are taking rest or busy working. Though having rising development in the last few years, existing OTOD services still suffer some limitations.

First, food delivery is sometimes completed by using bicycles or electric motorcars instead of cars visibleof the delivery cost which decreases the delivery efficiency and results in the limited delivery range in geography because of the slow speed. The take-out food is delivered by cars in some platforms the delivery cost is quite high for the requesters if they order the food frequently. Moreover it becomes difficult to deliver food on time during the peak hours because of the limited number of delivery staffs. Hence “Adaptive Large Neighbors Search Algorithm” is proposed to resolvethe matter with Android, PHP as front-end and MySQL as back-end. The developed proposed system fulfils the present need of Food ordering and Delivery. This projectis created to deliver the food through taxis with no delay, because the taxi plays a major travelling mode in present days.

Keywords: **-Spatial Crowdsourcing, online, ordering & delivery, task allocation, optimization**

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I. INTRODUCTION

The pervasive use of tablet and mobile devices leads to increased popularity of round-the-clock online shopping, which urges the sustainable development of logistics industry. For instance, online ordered products generated over one billion package deliveries in 2013, and this number is predicted to grow by 28.8% in 2018. To on-line shoppers, speed and cost are two major concerns, between which they pay relatively more attention to cost. Unfortunately, speed and cost usually conflict with each other in nature. In another word, speeding up the shipping process often implies more personnel and vehicles on the road, incurring more extra cost as a result. For example, users have to pay a high amount of money to enjoy the express service, such as 5 dollars per package if users want the same-day delivery service in US. Therefore, logistics services which can lower the cost but still ensure the arrivals of packages on time are preferable. With the sustainable development and proliferated daily use of positioning and mobile Internet technologies, rich data regarding status of the vehicles, passengers, and packages (e.g., real-time positions, origins and destinations of passengers and packages, available transport capacity of a vehicle) can be easily recorded and accessible in real time. In this context, crowdshipping (also termed as crowd logistics, crowdsourcing logistics) which receives the increasing attention from both academic and industrial communities in the last few years, has been recognized as a promising and cost-effective way to alleviate the contradiction by sending passengers and packages simultaneously in a shared space and transport network. In line with the previous research, with a particular focus on taxis, we propose having packages take hitchhiking rides collaboratively with existing taxis that are transporting passengers on the street, i.e., the existing mobility of taxi drivers.

II. REVIEW OF LITERATURE

Crowdsourcing has been used for many different applications, from problem solving [1] to various sensing tasks [1], [2], [3]. There exist two concrete papers that particularly targeted at the package delivery problem, leveraging the spatial and time overlaps between crowdsourcing workers. Specifically, Sadilek et al. [4] recruited a group of twitter users, asking one person to pass the assigned package to another twitter user that happened to be nearby (within a certain distance). However, the work had two main limitations: hard to trace and coordinate the users and not practical to ask a participant to make a dedicated trip to pass the package to another suitable user. Similarly, the work in [3] which employed mobile users based on the overlaps of space and time inferred from cell towers had similar limitations: the cell towers may be sparse in certain areas and the number of mobile users is limited.

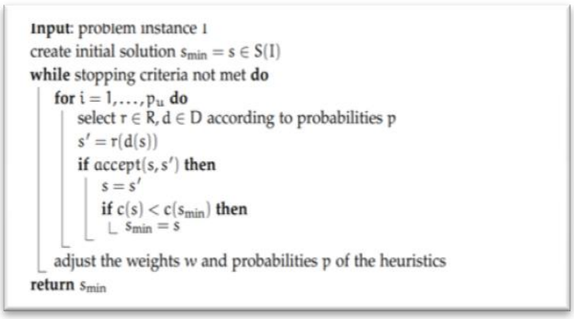
Compared to the proposed solutions in [6], [4], there are also some papers which intended to leverage the abundant existing passenger-delivery trips to hitchhike packages appeared in these two years [4], [3], [5], [6], [7], [8], [9]. Although the passenger flow and package flow are combined to be transported mixed, the authors fail to consider their distinct patterns in time and space. Specifically, they formulate the problem as the share-a-ride problem and insert the package requests into the passenger-delivery trips, which may not able to deliver packages successfully in real cases as we argued previously. To make the matters worse, in their solutions, during the passenger-sending course, taxis have to make several dedicated stops and detour, which degrades the service quality to passengers. At the current stage, the research on crowdsourced logistics mainly focused on issues regarding how to efficiently discover the 'optimal' package delivery paths and almost completely ignored the multi-criteria design of the package relay network [4], [5], [2].

III. PROPOSED WORK

The proposed system is designed to be deliver the food in taxis which travel in the same route in which the food needs to be delivered. Since the delivery place is far away area comparing to the motor bike delivery this taxi delivery is quicker. More over there are different taxis available for different destinations and the delivery can made in those taxis. The air pollution caused by delivery persons in motor bikes is also prevented and the delivery is also made quicker comparing to the motor bike delivery.

3.1 Adaptive Large Neighborhood Search (ALNS)

An Adaptive Large Neighborhood Search (ALNS) is the general idea to repeatedly remove requests from the answer and to reinsert them at a more profitable position using special destroy and repair heuristics mechanism. The massive Neighborhood Search (LNS) heuristic was proposed by Shaw. ALNS uses multiple destroy and repair heuristics rather thansingle search process. In each iteration, destroy and repair heuristic are applied. The choiceis predicated on the past success of the heuristics rather than local search heuristics which is applicable to local answers. ALNS works with a bigger search space, the so-called neighborhood of this solution. Within one iteration, ALNS can modify up to 30 − 40% of an answer. This characteristic is very useful with tightly constrained problems just like the RPDPTW. Without substantial changes, any heuristic would set into local optima.



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Input: problem instance I
create initial solution s_min = s ∈ S(I)
while stopping criteria not met do
    for i = 1,...,p_u do
        select r ∈ R, d ∈ D according to probabilities p
        s' = r(d(s))
        if accept(s, s') then
            s = s'
            if c(s) < c(s_min) then
                s_min = s
    adjust the weights w and probabilities p of the heuristics
return s_min
```

Figure 1: Adaptive Large Neighborhood Search Procedure

ALNS Algorithm Steps:

1. **input:** a feasible solution x
2. $x^b = x$;
3. **repeat**
4. $x^t = r(d(x))$;
5. if accept (x^t , x) then
6. $x = x^t$;
7. end if
8. if $c(x^t) < c(x^b)$ then
9. $x^b = x^t$;
10. end if
11. **until** stop criterion is met
12. return x^b

The variable $x^b$is the best solution observed during the search, x is the current solution and $x^t$is a temporary solution that can be discarded or promoted to the status of current solution. The function d(·) is the destroy method while r(·) is the repair method. More specifically, d(x) returns a copy of x that is partly destroyed. Applying r(·) to a partly destroyed solution repairs it, that is, it returns a feasible solution built from the destroyed one. In line 2 the global best solution is initialized. In line 4 the heuristic first applies the destroy method and then the repair method to obtain a new solution x^t. In line 5 the new solution is evaluated, and the heuristic determines whether this solution should become the new current solution (line 6) or whether it should be rejected. The accept function can be implemented in different ways. The simplest choice is to only accept improving solutions. Line 8 checks whether the new solution is better than the best known solution. Here c(x) denotes the objective value of solution x. The best solution is updated in line 9 if necessary. In line 11 the termination condition is checked. It is up to the implementer to choose the termination criterion,

IV. FINDINGS AND RESULTS

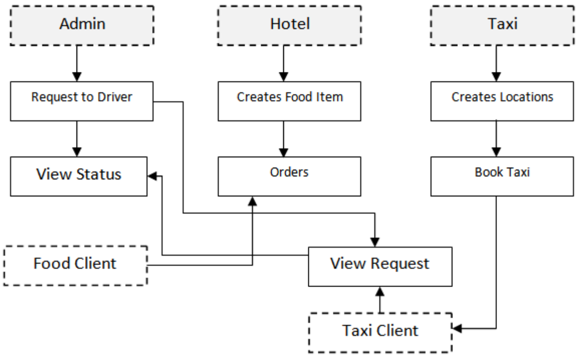

Figure 2 – Working process of the methodology

Results of the work:

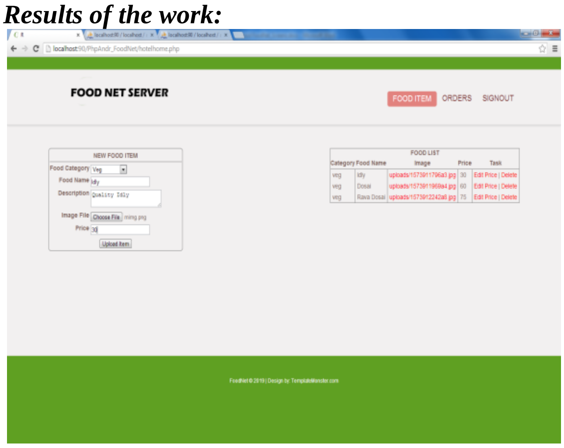

Figure 3 - Food Net Page

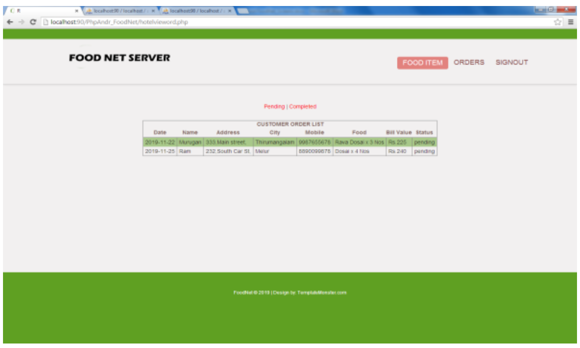

Figure 4 - Food Orders

but a limit on the number of iterations or a time limit would be typical choices. In line 12 the best solution found is returned. From the steps it can be noticed that the ALNS meta heuristic does not search the entire neighborhood of a solution, but merely samples this neighborhood.
The main idea behind the ALNS heuristic is that the large neighborhood allows the heuristic to navigate in the solution space easily, even if the instance is tightly constrained.

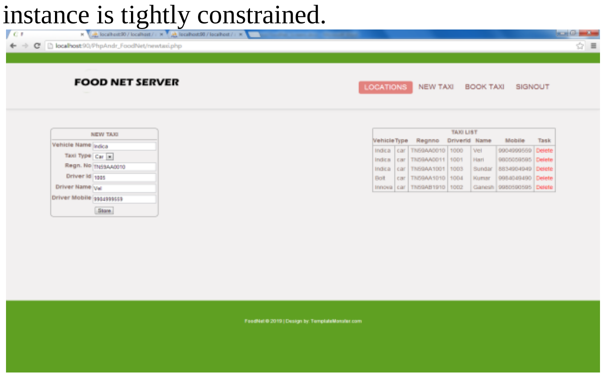

Figure 5 - New Taxi

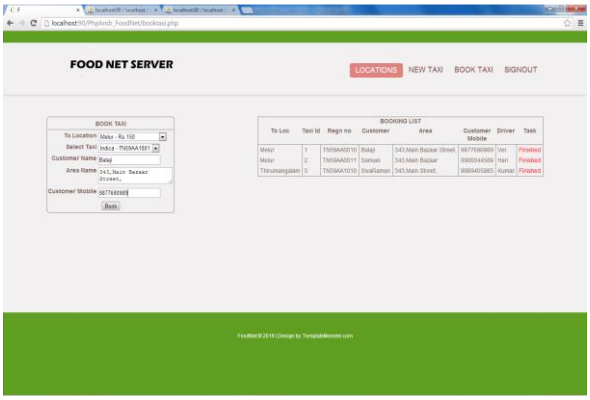

Figure 6 – Book Taxi

V. CONCLUSION

This paper provides a solution for the online order and delivery. Due to this merging of the food network with Taxi network all the food orders from remote places can be covered and the dropping of the food order is diminished considerably. Due to the lack of delivery boys most of the food orders are dropped, this system, offers a chance of delivering the food on the taxi that reaches the place in time. Thus the system fulfils the delivery of food orders in time and the traffic due to delivery vehicles is also reduced.

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