Commuter Ride Sharing Model: Need Of The Hour

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Abstract: Increasing congestion on roads in metropolitan region and increasing usage of private vehicles are the serious issues that affect the development of the transportation sector. So far, many researchers have studied the assessment of sustainable development of Urban Transport System and commuters' problem in megacity. Quite a lot of valuable concepts have been proposed like Uber share and Ola pool. Numerous data mining algorithms like clustering, machine learning, optimization etc. are used in this domain to get the Feasible Transport Model. Comparative analysis is the best practice to understand the problem and it will be beneficial to the community interested in exploring and extending such approaches further. In this paper, an attempt has been made to take an account of various approaches undertaken so far on Commuter ride sharing model which is very important for gap analysis.

Index Terms: Commuter problem, commuter solution, urban transport system, sustainable transport system, travel problem, ride sharing, ride pooling

1. INTRODUCTION

Home to the world's second (Mumbai) and third (Delhi) largest urban areas [1], Indian megacity faces immense challenges when it comes to urbanization, specifically in the field of transportation. Urban transport systems now face several challenges worldwide. The fiscal dimensions of the challenges are inclined to increase most attention. Traffic congestion practiced on metropolitan roads and highways have often been the source for development of many urban transport strategies and policies. The solution tends to the construction of additional infrastructure for vehicle use and not focusing enough on civilizing sustainable public transport systems. The number of vehicles being registered in Mumbai itself has staggeringly gone up to 700 per day [2]. One of the transport experts Mr. Rishi Aggarwal recently said in the Times of India report that the daily increase in new cars, bikes and other vehicles on roads has become a conundrum for those living in the city. "Can we do something like Singapore? They put a freeze on number of vehicles on the road. We need to urgently invest in good public transport which means using a smaller number of vehicles carrying more citizens. We also need to add more buses apart from Metro and other projects". So huge no of vehicles added per day on the road is a problem. Air pollution is one of the major problems in urban transport. Authors in [3] has given an assessment model for emitted pollutants through road transport where they concluded that use of alternative fuels and effective public transport system is required without delay rather than continuing increases in vehicle fleets and their utilization. If we talk about metro cities like Mumbai, residents are bounded to undergo physical and mental stress and suffer financial losses in terms of man-hours which are lost on working days due to traffic jam.

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The media, both print and electronic, have been constantly highlighting the sufferings of the commuters in mega city because of the nagging traffic problem. Based on the problem discussed above, the idea of people sharing a vehicle for a ride or set of people going together when their departure and destination locations are similar, is a timely and essential research area. People become more motivated when the vehicle ride whom they want to offer have similar socio-economic status, travel behaviour as well as same travel mode. For example, if some set of commuters use four-wheeler as travel mode having similar socio-economic status and location to travel to, then they can go together in one vehicle.The sustainable transport system has become widely accepted research problem in many academic communities over the past couple of years. However, measures aimed at behavioural change towards a more sustainable way of living faces complex restrictions and resistance. These constraints vary widely between different practices; behavioural changes at home such as introducing waste recycling or switching to energy saving light bulbs are often adopted by a significant number in society. In contrast, measures related to individual's daily mobility and tourist travel face much lower levels of acceptance and implementation – despite the considerable contribution of these activities to problems and that's why if people having same travel behaviour have same socio-economic status then physiologically also they may attempt to come together for societal cause.The prime advantages of commuter cluster detection affic Reduction, Carbon Emission Reduction, Road Safety, Time Management etc. The indirect advantages include Transportation studies, Urban Planning [4], Health monitoring [5]. As various tools and techniques are being used for the purpose, it is quite helpful to compare all the related work. This paper gives an analytical view of the research work done so far on the solution model of commuter problems. This paper also focuses on drawback of current systems and how we can propose one robust sustainable system to solve the problem. The remaining paper is organized as follows: Section II presents the research work found in the literature related to the commuter's problem solution models and work towards sustainable transportation model. Section III draws concluding remarks and further work.

2. DIFFERENT APPROACHES FOR COMMUTER RIDE SHARING MODEL

2.1 Ride Matching

Many researchers have extensively worked on ride matching problem and proposed different algorithms. Ride matching with small time windows is dynamic ride sharing. Two important tasks of ride matching problem are 1) Allocate riders to drivers 2) Outline the order and schedule of the riders' pickup and drop location. Authors in [6] have presented a genetic and an insertion heuristic algorithm to solve a dynamic ride-matching problem with time windows. The algorithm is flexible and can be easily tuned to balance between the solution's quality and the responsiveness of the algorithm. They Considered flexible path, multiple riders and one driver scenario. Authors in [7] have proposed mixed integer linear optimization problem to solve the unique ride-matching problem. They showed that considering checkpoint location can considerably increase the number of matched riders. In their work, they allow riders to specify the numbers of checkpoints they are willing to make and incorporate this measure in the formulation of the problem. So, many to many means multiple driver for one rider and multiple rider for one driver concept was there. Authors in [8] have used network partition technique and proved that if we consider single rider—single driver problem and a maximum accepted detour per traveller of 10 minutes, the number of trips could be reduced by 42%. This would reduce the accumulated daily system mileage by 2,30,000 km. In the given literature, they have considered dynamic ride sharing model and not considered any socio – economical aspect of the rider.

2.2 Location as privacy issue

`Privacy is the main issue in the dynamic ride sharing model because commuters need to share confidential location data about their trips to a server. Passenger must give this real time trip related information for each ride request which discloses passenger's travel pattern. To address this issue, [9][10] and many more have proposed a solution where information of travel path can be in encrypted format, but still, the data needs to be provided by the passenger. In this case, Ride sharing domain required some static ride sharing model where every time travel path data is not required.

2.3 Distance matter in the computation of ride matcher

Less work has been focused on how to reduce the computational complexity and restrict the search area. Authors in [11] have worked on a route planning approach that emphasizes on a limited potential search location for each vehicle by filtering out requests that violate rider service quality level.

2.4 Ride Sharing and Social Network

Authors in [12] have emphasized on the requirement of concerning social network into ride sharing found on their technology assessment but did not give an actual solution. Generally, people are more willing to share a ride with a friend or a friend of a friend rather than with a stranger; and even if they do, they have much lower tolerance for strangers. Authors in [13] have concluded that 98% of the people of Virginia Tech University would agree to take a ride from a friend, 69% agree to take from a friend of a friend, and only 7% from a stranger. The acceptance of shared independent vehicles is even more vague considering the comfortability of sitting next to a stranger in a limited space, without the presence of a typically trusted taxi driver [14]. Therefore, trust measure is an important subject for autonomous taxi-sharing. Social media is expressing state-of-the-art information about the user's activities. The Collaborative Activity-Based Ridesharing [15] is advantageous when linked with social network. So, there is a high chance for ride request acceptance if model is considering at least similar profile based on socio-economical aspects like equal gender, age, social status etc.

2.5 Ride sharing using significant intermediate meeting location

Intermediate meeting points allow the construction of routes with smaller diversions, while keeping an acceptable level of service for the riders. Riders may be picked up and dropped off at this significant meeting points that are within an adequate distance from their start or end trip. Some researcher had focused on this intermediate meeting points rather than just starting and ending location of the rider because due to this, driver can match many riders in between without increasing the number of stops on the trip. Authors in [16] [17] has shown that one can improve percentage of critical performance metrics, i.e., number of matched riders, number of matched participants, and mileage savings by introducing major meeting points in the ride sharing system. Taxi stand for taxi sharing; this concept is already existing earlier, and this is somewhat similar idea which can be implemented in private taxi also.

2.5 Travel behaviours using cluster analysis

Many scholars have worked on commuter's travel behaviour to analyse pattern of similar riders over the period of time and match similar user pattern using clustering. Researchers have used various data like GPS [18] [22], Survey [19] [21], website survey [20], Government Data etc. Authors in [21] have done survey which contain most of the socio-economical parameter, but parameters were used to examine only travelers' attitude towards carpooling. They concluded that 1) Societal, economic and environmental benefits will discourage car use, 2) Privileged parking, comfort level and convenience qualities are important factors in promoting carpooling. 3) Persons with strong faith in individual's confidentiality, safety, liberty in traveling and carpooling service constraints would discourage the use of carpooling facility.

2.6 Internet Based Car pooling

Many people commute by riding car alone. This requires the classification of groups of people making similar journeys at similar times. Ride-sourcing refers to an emerging urban mobility service. In this service, private car owners drive their own cars to offer "for-hire" drives to other riders. To promote the use of multioccupancy vehicles, this is one of the finest options. Numerous researchers have done extensive work on internet based carpooling system. Some has worked on Spatial Temporal Pattern Analysis [32] to provide behaviour pattern of taxi and internet-based ride sharing and conclude that in internet-based ride sharing drivers propose to make long distance trips while home to work and work to home commuting taxicab drivers account for very a smaller number of total drivers and they only attend a small number of commuting trips. Many scholar own patents on methods,

systems and computer program products [29] [30] [31] for ride matching. Still, Carpooling has not been very successful for social reasons, as most people find it more convenient to travel alone [33]. The reason behind this can be the socio-economical differences where people are not comfortable with each other. Also, authors in [20] raised two types of problem in carpooling viz. i) The Daily Car-Pooling Problem (DCPP) and ii) The Long-Term Car-Pooling Problem (LTCPP). Using clustering ant colony algorithm which was based on ant colony optimization, researcher gave optimized solution for LTCPP, but daily carpooling is still an issue to be solved.

2.7 Miscellaneous

Other major issues where researchers made their mark were how to change employee travel behaviour by initiating behaviour change strategies [26] or give incentive to the employee and attract them for shared ride [27] or ride sharing in driver less car [23] or ride sharing concept in health care [24] [25] or community-based trip sharing for urban commuters [28]. Uber ride sharing system is the important subject for study in the direction of sustainable transport system.

3 CONCLUSIONS

The cognitive attitudes can play an important role in evaluating the perceived advantages and disadvantages of designed algorithm in dynamic carpooling domain. With this attitude, some of the problems acknowledged in dynamic ridesharing systems like requirement of instantaneous successful coordination with respect to routes, timetables, and payment methods among participants. This is difficult because the proper information might not be known or even available to participants and decisions are prompt and dynamic. Another major drawback of dynamic carpooling system: i) If the rider is a commuter than he/she must hunt daily for car pool service. ii) Carpooling or sharing is only possible when driver will get rider on the go otherwise in the shared pool service also only one passenger completes his/her journey. Present software or algorithms in the market, however, mostly ignore the socio-psychological aspects of ridesharing, and thus cannot better exploit the full potential of this new travel mode. Study says that socio-economical aspect affects more for a long-term relationship. So, if the system identifies like-minded people for ride sharing then it will work better. Methodology based on prearranged ride is required today to solve the ride issue in which the trips are planned which means that the members agree to share a ride beforehand, naturally while they are not yet at the identical place. This is different from the spontaneous, so-called casual ride-sharing (in which riders and drivers establish a ride-share on the spot, like hitch-hiking or hailing a taxi on the side of the street). Correspondingly, at the same time algorithm should be designed in such a way that the cluster or ride arrangement will connect like-minded people for the ride. Taking into consideration Commuter Cluster Detection Model (CCDM) with socio-economic aspect to extract community who can share ride regularly is the problem to be solved in data mining. So, incarcerating this problem as a challenge, we can consider this problem as multidimension spatio-temporal cluster analysis problem to get the desire accuracy in CCDM.

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