Dynamic Carpooling Notification System For Rural Areas

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ABSTRACT

*With the increasing of energy resource's prices these days, the demands of energy resources already decreased in most countries of the world in general especially fuel resource. Beside that, rural areas in various countries suffer from lack of transportation services. Therefore, **D**ynamic **C**arpooling **N**otification **S**ystem (DCNS) by using mobile phone is proposed to overcome such problems, by allowing many passengers and drivers to be matched with each other instantly. By using mobile phone, an automatic process will be created in which drivers and passengers are matched to a shared ride wherever and whenever they need it. This paper describes the initial stage of this system by discussing the functionalities of this prototype.*

Keywords
Dynamic Carpooling, Rural and Mobile Phone Applications

1.0 INTRODUCTION

Transportation issues in rural areas of any country in the world vary according to the ranges in the number of population. Transportation services are among the challenges faced by people in the rural area. These include lack of services, limited availability of transportation facilities. In rural areas in Malaysia, as is the case of other countries' rural areas, lack of transportation services is among the challenges. The mobility and access to basic services is considered the most important thing among human's needs. On other hand, enhance rural transportation services can be a significant factor for sustainable economic development and to improve social-network.

The increased human mobility combined with high prices of resources like fuel has led people to reduce their cars usage, and look for alternative transportation options which provide solution for transportation costs. According to Helen (2005), the mode of travel does not necessarily need to be motorized or classical, but should be suitable with many of factors and the most important one is cost-effective. Carpooling has long been an option to aid the transportation sector to overcome many of challenges, where by using such method of transport, cost of traveling could be reduced through vehicle sharing among the carpoolers. Many countries encourage the use of this method of transport, to aids the passengers to find their rides with less cost and effort (http://www.valleymetro.maricopa.gov).

In fact the rural areas in Malaysia need such services to be as an alternative of classical transportation. In this study, DCNS prototype was deployed at Universiti Utara Malaysia (UUM), which is located in rural area, where the frequency of public transportation is quite low.

2.0 BACKGROUND

2.1 Carpooling

Carpooling concept (also known as Car-sharing, Ride-sharing, and Lift-sharing) is a system by which a person shares his or her private vehicle with one or more people that have similar destinations. This method is considered as inexpensive transport facility for both drivers and passengers.

Several countries encourage carpool to avoid many of problems that are faced in using the public transportation. In addition, carpooling is considered as very important in rural areas, where the transportation services in the rural areas are very slow compared to the one in the cities (Hildmann, 2001). According to Braid (1996), the idea of carpooling service is used to transport the passengers to intended destinations, due to the increasing in the human mobility and the quality of life, especially with the huge rise of prices resources, such as fuel.

Roberto et al (2004) stated that carpooling can be operated in two ways; daily carpooling problem (DCPP) and long-term car pooling problem (LCPP). In the DCPP case, according to Baldacci et al (2000), every day the number of persons has to declare their availability for picking up their colleagues in order to share their rides on a particular day. However, in the case of LCPP, Hildmann (2001) stated that each user is available both as a carpooler and as a client and the objective is to define pool rides where each user will in turn, on different days, pick up the remaining pool members.

The features of the carpooling system can be classified into two types, which are:

- Web sites, where this web collects all the information about the trips, which are opened to every navigator.
- The users of the system are from a restricted group, such as the employees of the same organization.

(http://www.valleymetro.maricopa.gov)

Personality and social factors also play important roles in people's willingness to participate in the proposed dynamic carpooling service. One of the greatest things we should keep in such system what the passengers and the drivers prefer, in fact this point is coming under the trust concept, and it is very important to the success of this dynamic system. According to Massaro (1998) one of the biggest obstacles to participate in carpooling is trust; trust might be related with uncertainty and also appears to share features with belief and faith. Trust is multidimensional. Three dimensions of trust have been identified by Bhattacherjee (2002), which are ability, integrity, and benevolence.

2.2 Dynamic Carpooling

Dynamic carpooling (also called real-time rides) is considered as an alternative mode of transportation because it does not require any change in transportation infrastructure, benefits both the drivers and the passengers, and no planning is required. According to Massaro, et al (2008), dynamic carpooling relies basically on frequent access to the ride matching service, it is important to serve the users to access the service easily. Access should be quick, and simple, dynamic carpooling opens the way to unscheduled trips throughout the city and surrounding areas.

The main aspect of dynamic carpooling is that it covers a wide areas and timetables that are not scheduled by public transportation and destinations required by the passengers. This makes it potentially easier, cheaper, and faster. Thus, dynamic carpooling is more inclusive than public transportation systems (Acocella, 2008).

In fact there are many of differences between dynamic carpooling and traditional carpooling. As shown in Table 1, dynamic carpooling is compared against traditional carpooling. According to Meyers et al (1999), regarding to shared rides in traditional carpooling are dependent basically on members knowing each other and traveling similar destinations at the same time, and traditional carpooling assume that the passenger has a fixed schedule and a fixed origin and destination. Based on this, the passengers share driving responsibilities. In contrast to dynamic system where considers each trip individually and must be able to arrange trips to different points at different times, that means each ride may be a different way, a different time, and a different group, and allowing many passengers and drivers to be matched with each other automatically in real time (Acocella, 2008). The best way to provide the passenger such this service is via mobile phone service, where as the mobile phones is widely used these days.

Table 1: *Differences between traditional and dynamic carpooling*

Comparison	Traditional carpool	Dynamic carpool
Carpool participants save money on gas, tolls, parking and vehicle maintenance	yes	yes
Requires a fixed plan of travel with regards to time and location	yes	no
Requires a long standing commitment between driver and passenger	yes	no
Flexible	no	yes
Feasible for daily commute	yes	yes

Oil prices recorded increase in the first half of 2008 and although some times the prices are going down they remain at levels that are high by historical standards, as result taxes on motor vehicle fuels have raised, and the focus of these taxes has shifted to controlling transportation. Therefore, dynamic carpooling is one of the methods for implementing cost-effective improvements to public transport. While carpooling is not usually managed by public transport or any other organization, it is important for it to be encouraged and supported to be able to attract the users (Congressional Budget Office, 2008).

3.0 PROPOSED DCNS

The described system is designed to support two types of users: drivers and passengers. Indeed this prototype has been proposed to be deployed firstly at University Utara Malaysia campus. Therefore, the drivers should be one of the university members (students or staff) to be able to offer trips. The passengers should also be one of the university members to be able to get their trips to various destinations. The diagram in Figure 2 shows the successive steps involved in the prototype execution.

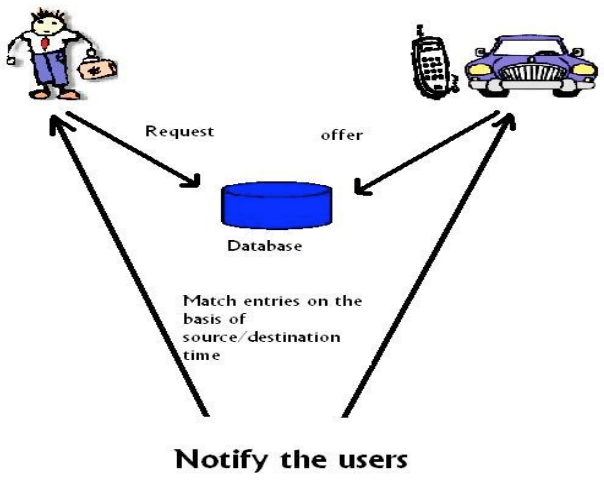

Figure 2: DCNS execution

The following are the execution steps of this system:

1. The driver offers a trip and its details by using mobile phone and this data is to be saved into the system database.
2. The passenger requests a trip to the system and provides the system by his/her personal information.
3. As soon as a passenger's request for a trip is submitted, the system tries matching it with a valid offer, if any present in the system.
4. As soon as a driver's offer is submitted, the system tries matching it with pending requests for trips, if any present in the system.
5. If a match is found, the result is shown to the passenger. Thus, the passenger can decide to join trip or not. The passenger who has decided to join a trip should insert some of brief personal information.
6. After these operations have performed, the system will send an e-mail to the driver to inform him/her that a new passenger has joined in the driver's offered trip. An e-mail is also will be sent to the driver, in case of the passenger's trip cancellation.

The prototype is implemented in the Microsoft Visual Web Developer 2005 Express Edition (C#). Microsoft Office Access is used as the database for storing the entries. Pocket PC is used as a simulator. Users who are offering or requesting for rides can browse the system easily using their mobile phones. Additionally, e-mails will be sent automatically to the drivers as soon as passengers have joined or cancel their trips. Gmail account has been used as the SMTP server. System.Net.Mail is used to send emails, due to its flexibility and efficiency.

Dynamic carpooling depends heavily on frequent access to the ride matching service, it is important that accessing the service be as easy as possible for passengers. Access to the system should be quick, simple, and easy. The best way to provide this access to users is via a mobile phone service. By using mobile phone for interactions with dynamic carpooling, access would be available at any time and any place. Passengers could arrange rides wherever and whenever they needed them, without preplanning for their trips. Additionally, this would allow drivers to designate any trip they are making as available for carpooling at the time of the trip.

The evaluation was conducted in terms if its usability testing and user's satisfaction on this prototype. The evaluation was conducted using interviews and questionnaires that were distributed among 10 UUM's staff and 30 UUM students that are living outside of Sintok town, a rural area, where UUM is located. All variables were measured using 5-points Likert scale. Please refer to Table 2 for the questionnaires and its descriptive analysis. For Question 7 - "It is easy to become skilful at using carpooling system." has the highest mean 4.33 with a standard deviation 0.959. For Question 12 - "It is easy to interact with carpooling system by using mobile phone." has the second highest means 4.30 with standard deviation 0.794". While, the lowest mean is 3.80 from the Question 3 - "Carpooling system would facilitate traveling." with standard deviation 1.095 and the second lowest mean is "Carpooling system is useful for my job." 3.85, with standard deviation 0.950.Below are several of the functions supported by this prototype:

Figure 3 : Display features one a user has gain access to DCNS from his or her mobile phone

Figure 4: A passenger search for a trip

Figure 5: Display the passenger search result

Figure 6 : Display the details about the selected trips

In order to gain the trust of passengers, this provide them preferences options, in which showing the some details about both passengers and drivers such as gender, smoking and the place of parking. Having this degree of options over the matches provided by dynamic carpooling may increase the trust in the service.

4.0 RELATED WORK

Several existing work have conducted to develop such dynamic systems. The availability of intelligent Transportation Systems (ITS) and other advanced technologies resulted in the inception and development of real-time or dynamic ride matching systems.

Table 2: *Questionnaires and its descriptive analysis*

Question	Description	Mean	Std. Deviation
1	Carpooling system will enable the commuter get his/her ride quickly.	4.17	.531
2	Carpooling system is useful for my job.	3.85	.950
3	Carpooling system would facilitate traveling.	3.80	1.095
4	Carpooling system will save my money.	4.17	.833
5	Learning to operate Carpooling system is easy.	4.13	.900
6	Interaction with Carpooling system is clear and understandable.	3.93	1.015
7	It is easy to become skilful at using carpooling system.	4.33	.959
8	Carpooling system is easy to use.	3.90	1.029
9	I completely satisfied in using the carpooling system.	4.10	.845
10	I feel by confident in using the Carpooling system.	3.97	.999
11	I feel comfortable by Using this Carpooling System.	3.87	1.358
12	It easy to interact with carpooling system by using mobile phone.	4.30	.794
13	The procedure through carpooling system by mobile phone was clear.	4.13	1.042
14	I found it easy to navigate my way to get my trip.	4.07	1.48

Early dynamic ride matching system has been implemented and many of them using telephone technology and have limited success. A model for a voice mail-based system in Seattle was developed but never implemented. The Sacramento real time ride matching demonstration, called rideshare express, has been tested as instant ride matching services in 1994 and 1995. Around 360 persons registered as drivers offering rides, but only ten requests for matches and one actual match were recorded (UBC TREK Carpool Team, 2001).

The Bellevue Smart Traveler project, undertaken by researchers at the University of Washington and others, was implemented from November 1993 to March 1994.

Telephone and paging technologies were used. Over the 5-month period of operation, the 53 participants offered approximately 496 rides. Participants sought 145 rides, but received information on possible rides only 40 (UBC TREK Carpool Team, 2001).

5.0 CONCLUSION

This paper describes the conceptual idea of DCNS, where it is still at its initial stage. There is still much work to be done in making this application ready to be used by the actual users. This application is also suitable to be used by any organizations such as by factories or schools, where by through dynamic carpooling, the mobility of its users can be improved and cost could be reduced.

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